

*FM 6-300*

*S/S Aug 76*

Reference

**FM 6-300**

**FIELD MANUAL**

**ARMY EPHEMERIS, 1976**

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WASHINGTON, D. C.

**HEADQUARTERS, DEPARTMENT OF THE ARMY**

**AUGUST 1975**



Effective 1 January 1976

FIELD MANUAL  
No. 6-300

HEADQUARTERS  
DEPARTMENT OF THE ARMY  
WASHINGTON, DC, 29 August 1975

# ARMY EPHEMERIS 1976

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## Section I. INTRODUCTION

1. *Purpose and Scope*

a. This manual is a compilation of tables and charts for use in computing astronomical azimuths for the field artillery. These tables and charts are used for computing azimuth of the sun or selected stars by either the altitude or hour-angle method. A special table (table 12), which is a tabular method of computing Polaris, is included for a rapid computation of a Polaris azimuth. The secant tables accompanying table 12 are permanent; however, the example portion of the explanatory part of the table will be updated annually. Tables and charts are also included to correct astronomic azimuth to grid azimuth to extend azimuth by simultaneous observation and to perform zone to zone transformation of azimuth.

b. Data contained in tables 2, 10a, 10b, 11, and 12 are current only for the year in which the manual is effective. These tables are compiled annually by the Target Acquisition Department, US Army Field Artillery School. The basic astronomical data

is furnished by the Nautical Almanac Office, US Naval Observatory.

c. Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. **Comments should be prepared using DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to the Commandant, US Army Field Artillery School, ATTN: ATSF-DOC-DL, Fort Sill, Oklahoma 73503.**

2. *Description of Tables and Charts*

This manual is intended to be used as a companion publication to FM 6-2, Field Artillery Survey. Details on the computation of astronomical azimuth and the use of these tables and charts are contained in FM 6-2.



## Section II. ASTRONOMICAL TABLES AND CHARTS

Table 1a. Astronomic Refraction Corrected for Temperature (Degrees)

TO BE SUBTRACTED FROM OBSERVED ALTITUDE OF SUN OR STAR

(Use values of observed altitude and temperature nearest the values tabulated as arguments.)

| Observed altitude |    | Temperature °F. |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|-------------------|----|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                   |    | -30             | -20   | -10   | 0     | +10   | +20   | +30   | +40   | +50   | +60   | +70   | +80   | +90   | +100  | +110  | +120  | +130  |
| 00                | 00 | 40-43           | 39-45 | 38-53 | 38-02 | 37-15 | 36-27 | 35-44 | 35-01 | 34-20 | 33-40 | 33-01 | 32-26 | 31-51 | 31-36 | 30-43 | 30-14 | 29-46 |
|                   | 20 | 35-57           | 35-06 | 34-20 | 33-35 | 32-53 | 32-11 | 31-33 | 30-55 | 30-18 | 29-44 | 29-09 | 28-38 | 28-07 | 27-37 | 27-07 | 26-42 | 26-17 |
|                   | 40 | 32-00           | 31-15 | 30-34 | 29-54 | 29-16 | 28-39 | 28-05 | 27-31 | 26-59 | 26-28 | 25-57 | 25-30 | 25-02 | 24-35 | 24-09 | 23-46 | 23-23 |
| 01                | 00 | 28-42           | 28-01 | 27-25 | 26-49 | 26-15 | 25-42 | 25-12 | 24-41 | 24-12 | 23-44 | 23-17 | 22-52 | 22-27 | 22-03 | 21-40 | 21-19 | 20-59 |
|                   | 20 | 25-55           | 25-19 | 24-46 | 24-13 | 23-43 | 23-13 | 22-45 | 22-18 | 21-51 | 21-26 | 21-02 | 20-39 | 20-17 | 19-55 | 19-44 | 19-15 | 18-57 |
|                   | 40 | 23-34           | 23-00 | 22-31 | 22-01 | 21-33 | 21-06 | 20-41 | 20-16 | 19-52 | 19-29 | 19-07 | 18-46 | 18-26 | 18-06 | 17-47 | 17-30 | 17-13 |
| 02                | 00 | 21-32           | 21-02 | 20-35 | 20-07 | 19-42 | 19-17 | 18-54 | 18-31 | 18-10 | 17-49 | 17-28 | 17-10 | 16-51 | 16-33 | 16-15 | 16-00 | 15-45 |
|                   | 20 | 19-48           | 19-20 | 18-54 | 18-29 | 18-06 | 17-43 | 17-22 | 17-01 | 16-41 | 16-22 | 16-03 | 15-46 | 15-29 | 15-12 | 14-56 | 14-42 | 14-28 |
|                   | 40 | 18-17           | 17-51 | 17-28 | 17-05 | 16-43 | 16-22 | 16-03 | 15-43 | 15-25 | 15-07 | 14-50 | 14-34 | 14-18 | 14-02 | 13-48 | 13-35 | 13-22 |
| 03                | 00 | 16-57           | 16-33 | 16-12 | 15-50 | 15-30 | 15-11 | 14-53 | 14-35 | 14-18 | 14-01 | 13-45 | 13-30 | 13-16 | 13-01 | 12-48 | 12-36 | 12-24 |
|                   | 20 | 15-47           | 15-25 | 15-05 | 14-45 | 14-27 | 14-08 | 13-51 | 13-35 | 13-19 | 13-04 | 12-48 | 12-35 | 12-21 | 12-08 | 11-55 | 11-44 | 11-32 |
|                   | 40 | 14-45           | 14-25 | 14-06 | 13-47 | 13-30 | 13-13 | 12-57 | 12-42 | 12-27 | 12-12 | 11-58 | 11-46 | 11-33 | 11-20 | 11-08 | 10-58 | 10-47 |
| 04                | 00 | 13-50           | 13-31 | 13-13 | 12-56 | 12-40 | 12-24 | 12-09 | 11-54 | 11-40 | 11-27 | 11-14 | 11-02 | 10-50 | 10-38 | 10-27 | 10-17 | 10-07 |
|                   | 20 | 13-01           | 12-43 | 12-26 | 12-10 | 11-55 | 11-40 | 11-26 | 11-12 | 10-59 | 10-46 | 10-34 | 10-23 | 10-11 | 10-00 | 09-50 | 09-40 | 09-31 |
|                   | 40 | 12-17           | 12-00 | 11-44 | 11-29 | 11-14 | 11-00 | 10-47 | 10-34 | 10-22 | 10-10 | 09-58 | 09-47 | 09-37 | 09-26 | 09-16 | 09-08 | 08-59 |
| 05                | 00 | 11-38           | 11-21 | 11-07 | 10-52 | 10-38 | 10-25 | 10-13 | 10-00 | 09-48 | 09-37 | 09-26 | 09-16 | 09-06 | 08-56 | 08-47 | 08-38 | 08-30 |
|                   | 20 | 11-02           | 10-46 | 10-32 | 10-18 | 10-05 | 09-53 | 09-41 | 09-29 | 09-18 | 09-07 | 08-57 | 08-47 | 08-38 | 08-28 | 08-19 | 08-12 | 08-04 |
|                   | 40 | 10-29           | 10-14 | 10-01 | 09-48 | 09-35 | 09-23 | 09-12 | 09-01 | 08-50 | 08-40 | 08-30 | 08-21 | 08-12 | 08-03 | 07-55 | 07-47 | 07-40 |
| 06                | 00 | 09-59           | 09-45 | 09-32 | 09-20 | 09-08 | 08-56 | 08-46 | 08-35 | 08-25 | 08-16 | 08-06 | 07-57 | 07-49 | 07-40 | 07-32 | 07-25 | 07-18 |
|                   | 20 | 09-32           | 09-18 | 09-06 | 08-54 | 08-43 | 08-32 | 08-22 | 08-12 | 08-02 | 07-53 | 07-44 | 07-35 | 07-27 | 07-19 | 07-11 | 07-05 | 06-58 |
|                   | 40 | 09-07           | 08-54 | 08-42 | 08-31 | 08-20 | 08-09 | 08-00 | 07-50 | 07-41 | 07-32 | 07-23 | 07-16 | 07-08 | 07-00 | 06-53 | 06-46 | 06-40 |
| 07                | 00 | 08-43           | 08-31 | 08-20 | 08-09 | 07-59 | 07-49 | 07-39 | 07-30 | 07-21 | 07-13 | 07-05 | 06-57 | 06-50 | 06-42 | 06-35 | 06-29 | 06-23 |
|                   | 20 | 08-22           | 08-10 | 08-00 | 07-49 | 07-39 | 07-30 | 07-21 | 07-12 | 07-03 | 06-55 | 06-47 | 06-40 | 06-33 | 06-26 | 06-19 | 06-13 | 06-07 |
|                   | 40 | 08-02           | 07-51 | 07-41 | 07-31 | 07-21 | 07-12 | 07-03 | 06-55 | 06-47 | 06-39 | 06-31 | 06-24 | 06-17 | 06-10 | 06-04 | 05-58 | 05-53 |
| 08                | 00 | 07-44           | 07-33 | 07-23 | 07-13 | 07-04 | 06-55 | 06-47 | 06-39 | 06-31 | 06-24 | 06-16 | 06-10 | 06-03 | 05-56 | 05-50 | 05-45 | 05-39 |
|                   | 20 | 07-27           | 07-16 | 07-07 | 06-57 | 06-49 | 06-40 | 06-32 | 06-24 | 06-17 | 06-09 | 06-02 | 05-56 | 05-49 | 05-43 | 05-37 | 05-32 | 05-27 |
|                   | 40 | 07-11           | 07-01 | 06-52 | 06-42 | 06-34 | 06-26 | 06-18 | 06-10 | 06-03 | 05-56 | 05-49 | 05-43 | 05-37 | 05-31 | 05-25 | 05-20 | 05-15 |
| 09                | 00 | 06-56           | 06-46 | 06-37 | 06-28 | 06-20 | 06-12 | 06-05 | 05-58 | 05-51 | 05-44 | 05-37 | 05-31 | 05-25 | 05-19 | 05-14 | 05-09 | 05-04 |
|                   | 20 | 06-42           | 06-32 | 06-24 | 06-15 | 06-08 | 06-00 | 05-53 | 05-46 | 05-39 | 05-32 | 05-26 | 05-20 | 05-14 | 05-08 | 05-03 | 04-58 | 04-54 |
|                   | 40 | 06-29           | 06-19 | 06-11 | 06-03 | 05-56 | 05-48 | 05-41 | 05-34 | 05-28 | 05-21 | 05-15 | 05-10 | 05-04 | 04-59 | 04-53 | 04-49 | 04-44 |
| 10                | 00 | 06-16           | 06-07 | 06-00 | 05-52 | 05-44 | 05-37 | 05-30 | 05-24 | 05-17 | 05-11 | 05-05 | 05-00 | 04-54 | 04-49 | 04-44 | 04-40 | 04-35 |
|                   | 20 | 06-05           | 05-56 | 05-48 | 05-41 | 05-34 | 05-27 | 05-20 | 05-14 | 05-08 | 05-02 | 04-56 | 04-51 | 04-45 | 04-40 | 04-35 | 04-31 | 04-27 |
|                   | 40 | 05-54           | 05-45 | 05-38 | 05-30 | 05-24 | 05-17 | 05-10 | 05-04 | 04-58 | 04-53 | 04-47 | 04-42 | 04-37 | 04-32 | 04-27 | 04-23 | 04-19 |
| 11                | 00 | 05-43           | 05-35 | 05-28 | 05-21 | 05-14 | 05-07 | 05-01 | 04-55 | 04-50 | 04-44 | 04-39 | 04-34 | 04-29 | 04-24 | 04-19 | 04-15 | 04-11 |
|                   | 20 | 05-34           | 05-26 | 05-19 | 05-12 | 05-05 | 04-59 | 04-53 | 04-47 | 04-41 | 04-36 | 04-31 | 04-26 | 04-21 | 04-16 | 04-12 | 04-08 | 04-04 |
|                   | 40 | 05-24           | 05-17 | 05-10 | 05-03 | 04-57 | 04-50 | 04-45 | 04-39 | 04-33 | 04-28 | 04-23 | 04-18 | 04-14 | 04-09 | 04-05 | 04-01 | 03-57 |
| 12                | 00 | 05-15           | 05-08 | 05-01 | 04-55 | 04-49 | 04-42 | 04-37 | 04-31 | 04-26 | 04-21 | 04-16 | 04-11 | 04-07 | 04-02 | 03-58 | 03-54 | 03-51 |
|                   | 20 | 05-07           | 05-00 | 04-53 | 04-47 | 04-41 | 04-35 | 04-30 | 04-24 | 04-19 | 04-14 | 04-09 | 04-05 | 04-00 | 03-56 | 03-52 | 03-48 | 03-44 |
|                   | 40 | 04-59           | 04-52 | 04-46 | 04-39 | 04-34 | 04-28 | 04-21 | 04-17 | 04-12 | 04-07 | 04-03 | 03-58 | 03-54 | 03-50 | 03-46 | 03-42 | 03-39 |

Table 1a. Astronomic Refraction Corrected for Temperature (Degrees)—Continued

| Observed altitudes | Temperature °F. |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|--------------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                    | -30             | -20   | -10   | 0     | +10   | +20   | +30   | +40   | +50   | +60   | +70   | +80   | +90   | +100  | +110  | +120  | +130  |
| 13 00              | 04-51           | 04-45 | 04-38 | 04-32 | 04-27 | 04-21 | 04-16 | 04-11 | 04-08 | 04-01 | 03-56 | 03-52 | 03-48 | 03-44 | 03-40 | 03-36 | 03-33 |
| 20                 | 04-44           | 04-37 | 04-31 | 04-25 | 04-20 | 04-14 | 04-09 | 04-04 | 04-00 | 03-55 | 03-50 | 03-46 | 03-42 | 03-38 | 03-34 | 03-31 | 03-27 |
| 40                 | 04-37           | 04-31 | 04-25 | 04-19 | 04-14 | 04-08 | 04-03 | 03-58 | 03-54 | 03-49 | 03-45 | 03-41 | 03-37 | 03-33 | 03-29 | 03-26 | 03-23 |
| 14 00              | 04-31           | 04-24 | 04-19 | 04-13 | 04-08 | 04-02 | 03-58 | 03-53 | 03-48 | 03-44 | 03-40 | 03-36 | 03-32 | 03-28 | 03-24 | 03-21 | 03-19 |
| 20                 | 04-24           | 04-18 | 04-12 | 04-07 | 04-02 | 03-57 | 03-52 | 03-47 | 03-43 | 03-39 | 03-34 | 03-31 | 03-27 | 03-23 | 03-19 | 03-16 | 03-13 |
| 40                 | 04-18           | 04-12 | 04-07 | 04-01 | 03-56 | 03-51 | 03-47 | 03-41 | 03-38 | 03-34 | 03-29 | 03-26 | 03-22 | 03-18 | 03-15 | 03-12 | 03-09 |
| 16 00              | 04-12           | 04-08 | 04-01 | 03-56 | 03-51 | 03-46 | 03-42 | 03-37 | 03-33 | 03-29 | 03-25 | 03-21 | 03-17 | 03-14 | 03-10 | 03-07 | 03-04 |
| 20                 | 04-07           | 04-01 | 03-56 | 03-51 | 03-46 | 03-41 | 03-37 | 03-32 | 03-28 | 03-24 | 03-20 | 03-17 | 03-13 | 03-10 | 03-06 | 03-03 | 03-00 |
| 40                 | 04-01           | 03-56 | 03-51 | 03-46 | 03-41 | 03-36 | 03-32 | 03-28 | 03-24 | 03-20 | 03-16 | 03-12 | 03-09 | 03-05 | 03-02 | 02-59 | 02-57 |
| 16 00              | 03-56           | 03-51 | 03-46 | 03-41 | 03-36 | 03-32 | 03-27 | 03-23 | 03-19 | 03-15 | 03-12 | 03-08 | 03-05 | 03-01 | 02-58 | 02-55 | 02-53 |
| 20                 | 03-51           | 03-46 | 03-41 | 03-36 | 03-32 | 03-27 | 03-23 | 03-19 | 03-15 | 03-12 | 03-08 | 03-04 | 03-01 | 02-58 | 02-55 | 02-52 | 02-49 |
| 40                 | 03-47           | 03-41 | 03-36 | 03-32 | 03-27 | 03-23 | 03-19 | 03-15 | 03-11 | 03-07 | 03-04 | 03-00 | 02-57 | 02-54 | 02-51 | 02-48 | 02-46 |
| 17 00              | 03-42           | 03-37 | 03-32 | 03-27 | 03-23 | 03-19 | 03-15 | 03-11 | 03-07 | 03-04 | 03-00 | 02-57 | 02-54 | 02-51 | 02-48 | 02-45 | 02-42 |
| 20                 | 03-38           | 03-32 | 03-28 | 03-23 | 03-19 | 03-15 | 03-11 | 03-07 | 03-03 | 03-00 | 02-56 | 02-53 | 02-50 | 02-47 | 02-44 | 02-42 | 02-39 |
| 40                 | 03-33           | 03-28 | 03-24 | 03-19 | 03-15 | 03-11 | 03-07 | 03-03 | 03-00 | 02-56 | 02-53 | 02-50 | 02-47 | 02-44 | 02-41 | 02-38 | 02-36 |
| 18 00              | 03-29           | 03-24 | 03-20 | 03-15 | 03-11 | 03-07 | 03-04 | 03-00 | 02-56 | 02-53 | 02-50 | 02-47 | 02-44 | 02-41 | 02-38 | 02-35 | 02-33 |
| 20                 | 03-25           | 03-20 | 03-16 | 03-12 | 03-08 | 03-04 | 03-00 | 02-56 | 02-53 | 02-50 | 02-46 | 02-43 | 02-41 | 02-38 | 02-35 | 02-32 | 02-30 |
| 40                 | 03-21           | 03-17 | 03-12 | 03-08 | 03-04 | 03-00 | 02-57 | 02-53 | 02-50 | 02-46 | 02-43 | 02-40 | 02-37 | 02-35 | 02-32 | 02-30 | 02-27 |
| 19 00              | 03-18           | 03-13 | 03-09 | 03-05 | 03-01 | 02-57 | 02-53 | 02-50 | 02-47 | 02-43 | 02-40 | 02-37 | 02-35 | 02-32 | 02-29 | 02-27 | 02-24 |
| 20                 | 03-14           | 03-09 | 03-05 | 03-01 | 02-58 | 02-54 | 02-50 | 02-47 | 02-44 | 02-40 | 02-37 | 02-35 | 02-32 | 02-29 | 02-26 | 02-24 | 02-22 |
| 40                 | 03-10           | 03-06 | 03-02 | 02-58 | 02-54 | 02-51 | 02-47 | 02-44 | 02-41 | 02-38 | 02-34 | 02-32 | 02-29 | 02-26 | 02-24 | 02-21 | 02-19 |
| 20 00              | 03-07           | 03-03 | 02-59 | 02-55 | 02-51 | 02-48 | 02-44 | 02-41 | 02-38 | 02-35 | 02-32 | 02-29 | 02-26 | 02-24 | 02-21 | 02-19 | 02-17 |
| 20                 | 03-04           | 02-59 | 02-56 | 02-52 | 02-48 | 02-45 | 02-41 | 02-38 | 02-35 | 02-32 | 02-29 | 02-26 | 02-24 | 02-21 | 02-19 | 02-17 | 02-14 |
| 40                 | 03-01           | 02-56 | 02-53 | 02-49 | 02-45 | 02-42 | 02-39 | 02-35 | 02-32 | 02-29 | 02-27 | 02-24 | 02-21 | 02-19 | 02-16 | 02-14 | 02-12 |
| 21 00              | 02-58           | 02-53 | 02-50 | 02-46 | 02-42 | 02-39 | 02-36 | 02-33 | 02-30 | 02-27 | 02-24 | 02-21 | 02-19 | 02-16 | 02-14 | 02-12 | 02-10 |
| 20                 | 02-55           | 02-50 | 02-47 | 02-43 | 02-40 | 02-36 | 02-33 | 02-30 | 02-27 | 02-24 | 02-22 | 02-19 | 02-17 | 02-14 | 02-12 | 02-10 | 02-08 |
| 40                 | 02-52           | 02-48 | 02-44 | 02-40 | 02-37 | 02-34 | 02-31 | 02-28 | 02-25 | 02-22 | 02-19 | 02-17 | 02-14 | 02-12 | 02-10 | 02-07 | 02-05 |
| 22 00              | 02-49           | 02-45 | 02-41 | 02-38 | 02-34 | 02-31 | 02-28 | 02-25 | 02-22 | 02-20 | 02-17 | 02-14 | 02-12 | 02-10 | 02-07 | 02-05 | 02-03 |
| 20                 | 02-46           | 02-42 | 02-39 | 02-35 | 02-32 | 02-29 | 02-26 | 02-23 | 02-20 | 02-17 | 02-15 | 02-12 | 02-10 | 02-08 | 02-05 | 02-03 | 02-01 |
| 40                 | 02-43           | 02-40 | 02-36 | 02-33 | 02-30 | 02-26 | 02-23 | 02-21 | 02-18 | 02-15 | 02-13 | 02-10 | 02-08 | 02-06 | 02-03 | 02-01 | 01-59 |
| 23 00              | 02-41           | 02-37 | 02-34 | 02-30 | 02-27 | 02-24 | 02-21 | 02-18 | 02-16 | 02-13 | 02-10 | 02-08 | 02-06 | 02-04 | 02-01 | 01-59 | 01-58 |
| 20                 | 02-38           | 02-34 | 02-31 | 02-28 | 02-25 | 02-22 | 02-19 | 02-16 | 02-13 | 02-11 | 02-08 | 02-06 | 02-04 | 02-02 | 01-59 | 01-58 | 01-56 |
| 40                 | 02-36           | 02-32 | 02-29 | 02-26 | 02-23 | 02-20 | 02-17 | 02-14 | 02-11 | 02-09 | 02-06 | 02-04 | 02-02 | 02-00 | 01-58 | 01-56 | 01-54 |
| 24 00              | 02-33           | 02-30 | 02-26 | 02-23 | 02-20 | 02-17 | 02-15 | 02-12 | 02-09 | 02-07 | 02-04 | 02-02 | 02-00 | 01-58 | 01-56 | 01-54 | 01-52 |
| 20                 | 02-31           | 02-28 | 02-24 | 02-21 | 02-18 | 02-15 | 02-13 | 02-10 | 02-07 | 02-05 | 02-03 | 02-00 | 01-58 | 01-56 | 01-54 | 01-52 | 01-50 |
| 40                 | 02-29           | 02-25 | 02-22 | 02-19 | 02-16 | 02-13 | 02-11 | 02-08 | 02-05 | 02-03 | 02-01 | 01-59 | 01-56 | 01-54 | 01-52 | 01-50 | 01-49 |
| 25 00              | 02-28           | 02-23 | 02-20 | 02-17 | 02-14 | 02-11 | 02-09 | 02-08 | 02-04 | 02-01 | 01-59 | 01-57 | 01-55 | 01-53 | 01-51 | 01-49 | 01-47 |
| 20                 | 02-24           | 02-21 | 02-18 | 02-15 | 02-12 | 02-09 | 02-07 | 02-04 | 02-02 | 02-00 | 01-57 | 01-55 | 01-53 | 01-51 | 01-49 | 01-47 | 01-46 |
| 40                 | 02-22           | 02-19 | 02-16 | 02-13 | 02-10 | 02-07 | 02-05 | 02-02 | 02-00 | 01-58 | 01-55 | 01-53 | 01-51 | 01-49 | 01-47 | 01-46 | 01-44 |
| 26 00              | 02-20           | 02-17 | 02-14 | 02-11 | 02-08 | 02-06 | 02-03 | 02-01 | 01-58 | 01-56 | 01-54 | 01-52 | 01-50 | 01-48 | 01-46 | 01-44 | 01-42 |
| 20                 | 02-18           | 02-15 | 02-12 | 02-09 | 02-06 | 02-04 | 02-01 | 01-59 | 01-56 | 01-54 | 01-52 | 01-50 | 01-48 | 01-46 | 01-44 | 01-43 | 01-41 |
| 40                 | 02-16           | 02-13 | 02-10 | 02-07 | 02-05 | 02-02 | 02-00 | 01-57 | 01-55 | 01-53 | 01-50 | 01-48 | 01-47 | 01-45 | 01-43 | 01-41 | 01-40 |



Table 1a. Astronomic Refraction Corrected for Temperature. (Degrees)—Continued

| Observed<br>altitude | Temperature °F. |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|----------------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                      | -30             | -20   | -10   | 0     | +10   | +20   | +30   | +40   | +50   | +60   | +70   | +80   | +90   | +100  | +110  | +120  | +130  |
| 27 00                | 02-14           | 02-11 | 02-08 | 02-05 | 02-03 | 02-00 | 01-58 | 01-55 | 01-53 | 01-51 | 01-49 | 01-47 | 01-45 | 01-43 | 01-41 | 01-40 | 01-38 |
| 27 20                | 02-12           | 02-09 | 02-06 | 02-04 | 02-01 | 01-59 | 01-56 | 01-54 | 01-52 | 01-49 | 01-47 | 01-45 | 01-44 | 01-42 | 01-40 | 01-38 | 01-37 |
| 27 40                | 02-10           | 02-07 | 02-05 | 02-02 | 01-59 | 01-57 | 01-55 | 01-52 | 01-50 | 01-48 | 01-46 | 01-44 | 01-42 | 01-40 | 01-38 | 01-37 | 01-35 |
| 28 00                | 02-09           | 02-06 | 02-03 | 02-00 | 01-58 | 01-55 | 01-53 | 01-51 | 01-48 | 01-46 | 01-44 | 01-43 | 01-41 | 01-39 | 01-37 | 01-36 | 01-34 |
| 28 20                | 02-07           | 02-04 | 02-01 | 01-59 | 01-56 | 01-54 | 01-51 | 01-49 | 01-47 | 01-45 | 01-43 | 01-41 | 01-39 | 01-37 | 01-36 | 01-34 | 01-33 |
| 28 40                | 02-05           | 02-02 | 02-00 | 01-57 | 01-54 | 01-52 | 01-50 | 01-48 | 01-46 | 01-43 | 01-41 | 01-40 | 01-38 | 01-36 | 01-34 | 01-33 | 01-31 |
| 29 00                | 02-03           | 02-01 | 01-58 | 01-55 | 01-53 | 01-51 | 01-48 | 01-46 | 01-44 | 01-42 | 01-40 | 01-38 | 01-37 | 01-35 | 01-33 | 01-32 | 01-30 |
| 29 20                | 02-02           | 01-59 | 01-56 | 01-54 | 01-51 | 01-49 | 01-47 | 01-45 | 01-43 | 01-41 | 01-39 | 01-37 | 01-35 | 01-34 | 01-32 | 01-30 | 01-29 |
| 29 40                | 02-00           | 01-57 | 01-55 | 01-52 | 01-50 | 01-48 | 01-45 | 01-43 | 01-41 | 01-39 | 01-37 | 01-36 | 01-34 | 01-32 | 01-31 | 01-29 | 01-28 |
| 30 00                | 01-59           | 01-56 | 01-53 | 01-51 | 01-48 | 01-46 | 01-44 | 01-42 | 01-40 | 01-38 | 01-36 | 01-34 | 01-33 | 01-31 | 01-30 | 01-28 | 01-27 |
| 30 20                | 01-57           | 01-54 | 01-52 | 01-49 | 01-47 | 01-45 | 01-43 | 01-41 | 01-39 | 01-37 | 01-35 | 01-33 | 01-32 | 01-30 | 01-28 | 01-27 | 01-25 |
| 30 40                | 01-56           | 01-53 | 01-50 | 01-48 | 01-46 | 01-43 | 01-41 | 01-39 | 01-37 | 01-36 | 01-34 | 01-32 | 01-30 | 01-29 | 01-27 | 01-26 | 01-24 |
| 31 00                | 01-54           | 01-51 | 01-49 | 01-46 | 01-44 | 01-42 | 01-40 | 01-38 | 01-36 | 01-34 | 01-32 | 01-31 | 01-29 | 01-28 | 01-26 | 01-25 | 01-23 |
| 31 20                | 01-52           | 01-50 | 01-47 | 01-45 | 01-43 | 01-41 | 01-39 | 01-37 | 01-35 | 01-33 | 01-31 | 01-30 | 01-28 | 01-26 | 01-25 | 01-24 | 01-22 |
| 31 40                | 01-51           | 01-48 | 01-46 | 01-44 | 01-42 | 01-39 | 01-37 | 01-35 | 01-34 | 01-32 | 01-30 | 01-28 | 01-27 | 01-25 | 01-24 | 01-22 | 01-21 |
| 32 00                | 01-50           | 01-47 | 01-45 | 01-42 | 01-40 | 01-38 | 01-36 | 01-34 | 01-32 | 01-31 | 01-29 | 01-27 | 01-26 | 01-24 | 01-23 | 01-21 | 01-20 |
| 32 30                | 01-48           | 01-45 | 01-43 | 01-40 | 01-38 | 01-36 | 01-34 | 01-33 | 01-31 | 01-29 | 01-27 | 01-26 | 01-24 | 01-23 | 01-21 | 01-20 | 01-19 |
| 33 00                | 01-45           | 01-43 | 01-41 | 01-39 | 01-36 | 01-34 | 01-33 | 01-31 | 01-29 | 01-27 | 01-26 | 01-24 | 01-22 | 01-21 | 01-20 | 01-18 | 01-17 |
| 33 30                | 01-44           | 01-41 | 01-39 | 01-37 | 01-35 | 01-33 | 01-31 | 01-29 | 01-27 | 01-26 | 01-24 | 01-22 | 01-21 | 01-20 | 01-18 | 01-17 | 01-16 |
| 34 00                | 01-42           | 01-39 | 01-37 | 01-35 | 01-33 | 01-31 | 01-29 | 01-27 | 01-26 | 01-24 | 01-22 | 01-21 | 01-19 | 01-18 | 01-17 | 01-15 | 01-14 |
| 34 30                | 01-40           | 01-37 | 01-35 | 01-33 | 01-31 | 01-29 | 01-28 | 01-26 | 01-24 | 01-23 | 01-21 | 01-19 | 01-18 | 01-17 | 01-15 | 01-14 | 01-13 |
| 35 00                | 01-38           | 01-36 | 01-33 | 01-31 | 01-30 | 01-28 | 01-26 | 01-24 | 01-22 | 01-21 | 01-19 | 01-18 | 01-17 | 01-15 | 01-14 | 01-13 | 01-12 |
| 35 30                | 01-36           | 01-34 | 01-32 | 01-30 | 01-28 | 01-26 | 01-24 | 01-23 | 01-21 | 01-19 | 01-18 | 01-17 | 01-15 | 01-14 | 01-12 | 01-11 | 01-10 |
| 36 00                | 01-34           | 01-32 | 01-30 | 01-28 | 01-26 | 01-24 | 01-23 | 01-21 | 01-20 | 01-18 | 01-16 | 01-15 | 01-14 | 01-12 | 01-11 | 01-10 | 01-09 |
| 36 30                | 01-33           | 01-30 | 01-28 | 01-27 | 01-25 | 01-23 | 01-21 | 01-20 | 01-18 | 01-17 | 01-15 | 01-14 | 01-12 | 01-11 | 01-10 | 01-09 | 01-08 |
| 37 00                | 01-31           | 01-29 | 01-27 | 01-25 | 01-23 | 01-21 | 01-20 | 01-18 | 01-17 | 01-15 | 01-14 | 01-12 | 01-11 | 01-10 | 01-09 | 01-08 | 01-06 |
| 37 30                | 01-29           | 01-27 | 01-25 | 01-23 | 01-22 | 01-20 | 01-18 | 01-17 | 01-15 | 01-14 | 01-12 | 01-11 | 01-10 | 01-09 | 01-07 | 01-06 | 01-05 |
| 38 00                | 01-28           | 01-26 | 01-24 | 01-22 | 01-20 | 01-19 | 01-17 | 01-15 | 01-14 | 01-13 | 01-11 | 01-10 | 01-09 | 01-07 | 01-06 | 01-05 | 01-04 |
| 38 30                | 01-26           | 01-24 | 01-22 | 01-21 | 01-19 | 01-17 | 01-16 | 01-14 | 01-13 | 01-11 | 01-10 | 01-09 | 01-07 | 01-06 | 01-05 | 01-04 | 01-03 |
| 39 00                | 01-25           | 01-23 | 01-21 | 01-19 | 01-17 | 01-16 | 01-14 | 01-13 | 01-11 | 01-10 | 01-09 | 01-07 | 01-06 | 01-05 | 01-04 | 01-03 | 01-02 |
| 39 30                | 01-23           | 01-21 | 01-19 | 01-18 | 01-16 | 01-14 | 01-13 | 01-12 | 01-10 | 01-09 | 01-07 | 01-06 | 01-05 | 01-04 | 01-03 | 01-02 | 01-01 |
| 40 00                | 01-22           | 01-20 | 01-18 | 01-16 | 01-15 | 01-13 | 01-12 | 01-10 | 01-09 | 01-08 | 01-06 | 01-05 | 01-04 | 01-03 | 01-02 | 01-01 | 01-00 |
| 40 30                | 01-20           | 01-18 | 01-17 | 01-15 | 01-13 | 01-12 | 01-10 | 01-09 | 01-08 | 01-06 | 01-05 | 01-04 | 01-03 | 01-02 | 01-01 | 01-00 | 00-59 |
| 41 00                | 01-19           | 01-17 | 01-15 | 01-14 | 01-12 | 01-11 | 01-09 | 01-09 | 01-06 | 01-05 | 01-04 | 01-03 | 01-02 | 01-01 | 01-00 | 00-59 | 00-58 |
| 41 30                | 01-18           | 01-16 | 01-14 | 01-12 | 01-11 | 01-09 | 01-08 | 01-07 | 01-05 | 01-04 | 01-03 | 01-02 | 01-01 | 01-00 | 00-59 | 00-58 | 00-57 |
| 42 00                | 01-16           | 01-14 | 01-13 | 01-11 | 01-10 | 01-08 | 01-07 | 01-05 | 01-04 | 01-03 | 01-02 | 01-01 | 01-00 | 00-58 | 00-57 | 00-57 | 00-56 |
| 42 30                | 01-15           | 01-13 | 01-11 | 01-10 | 01-08 | 01-07 | 01-06 | 01-04 | 01-03 | 01-02 | 01-01 | 01-00 | 00-59 | 00-57 | 00-56 | 00-56 | 00-55 |
| 43 00                | 01-14           | 01-12 | 01-10 | 01-09 | 01-07 | 01-06 | 01-05 | 01-03 | 01-02 | 01-01 | 01-00 | 00-59 | 00-58 | 00-56 | 00-55 | 00-55 | 00-54 |
| 43 30                | 01-12           | 01-11 | 01-09 | 01-08 | 01-06 | 01-05 | 01-04 | 01-02 | 01-01 | 01-00 | 00-59 | 00-58 | 00-57 | 00-56 | 00-55 | 00-54 | 00-53 |

Table 1a. Astronomic Refraction Corrected for Temperature (Degrees)—Continued

| Observed altitude | Temperature °F. |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|-------------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                   | -30             | -20   | -10   | 0     | +10   | +20   | +30   | +40   | +50   | +60   | +70   | +80   | +90   | +100  | +110  | +120  | +130  |
| • •               | • •             | • •   | • •   | • •   | • •   | • •   | • •   | • •   | • •   | • •   | • •   | • •   | • •   | • •   | • •   | • •   | • •   |
| 44 00             | 01-11           | 01-09 | 01-08 | 01-06 | 01-05 | 01-04 | 01-02 | 01-01 | 01-00 | 00-59 | 00-58 | 00-57 | 00-56 | 00-55 | 00-54 | 00-53 | 00-52 |
| 30                | 01-10           | 01-08 | 01-07 | 01-05 | 01-04 | 01-03 | 01-01 | 01-00 | 00-59 | 00-58 | 00-57 | 00-56 | 00-55 | 00-54 | 00-53 | 00-52 | 00-51 |
| 45 00             | 01-09           | 01-07 | 01-06 | 01-04 | 01-03 | 01-01 | 01-00 | 00-59 | 00-58 | 00-57 | 00-56 | 00-55 | 00-54 | 00-53 | 00-52 | 00-51 | 00-50 |
| 30                | 01-07           | 01-06 | 01-04 | 01-03 | 01-02 | 01-00 | 00-59 | 00-58 | 00-57 | 00-56 | 00-55 | 00-54 | 00-53 | 00-52 | 00-51 | 00-50 | 00-49 |
| 46 00             | 01-06           | 01-05 | 01-03 | 01-02 | 01-01 | 00-59 | 00-58 | 00-57 | 00-56 | 00-55 | 00-54 | 00-53 | 00-52 | 00-51 | 00-50 | 00-49 | 00-48 |
| 30                | 01-05           | 01-04 | 01-02 | 01-01 | 01-00 | 00-58 | 00-57 | 00-56 | 00-55 | 00-54 | 00-53 | 00-52 | 00-51 | 00-50 | 00-49 | 00-48 | 00-48 |
| 47 00             | 01-04           | 01-03 | 01-01 | 01-00 | 00-59 | 00-57 | 00-56 | 00-55 | 00-54 | 00-53 | 00-52 | 00-51 | 00-50 | 00-49 | 00-48 | 00-48 | 00-47 |
| 30                | 01-03           | 01-01 | 01-00 | 00-59 | 00-58 | 00-56 | 00-55 | 00-54 | 00-53 | 00-52 | 00-51 | 00-50 | 00-49 | 00-48 | 00-47 | 00-47 | 00-46 |
| 48 00             | 01-02           | 01-00 | 00-59 | 00-58 | 00-57 | 00-55 | 00-54 | 00-53 | 00-52 | 00-51 | 00-50 | 00-49 | 00-48 | 00-47 | 00-47 | 00-46 | 00-45 |
| 30                | 01-01           | 00-59 | 00-58 | 00-57 | 00-56 | 00-54 | 00-53 | 00-52 | 00-51 | 00-50 | 00-49 | 00-48 | 00-48 | 00-47 | 00-46 | 00-45 | 00-44 |
| 49 00             | 01-00           | 00-58 | 00-57 | 00-56 | 00-55 | 00-53 | 00-52 | 00-51 | 00-50 | 00-49 | 00-48 | 00-48 | 00-47 | 00-46 | 00-45 | 00-44 | 00-44 |
| 30                | 00-59           | 00-57 | 00-56 | 00-55 | 00-54 | 00-52 | 00-51 | 00-50 | 00-49 | 00-48 | 00-48 | 00-47 | 00-46 | 00-45 | 00-44 | 00-44 | 00-43 |
| 50 00             | 00-58           | 00-56 | 00-55 | 00-54 | 00-53 | 00-52 | 00-51 | 00-50 | 00-49 | 00-48 | 00-47 | 00-46 | 00-45 | 00-44 | 00-43 | 00-43 | 00-42 |
| 51 00             | 00-56           | 00-54 | 00-53 | 00-52 | 00-51 | 00-50 | 00-49 | 00-48 | 00-47 | 00-46 | 00-45 | 00-44 | 00-44 | 00-43 | 00-42 | 00-41 | 00-41 |
| 52 00             | 00-54           | 00-52 | 00-51 | 00-50 | 00-49 | 00-48 | 00-47 | 00-46 | 00-45 | 00-44 | 00-43 | 00-43 | 00-42 | 00-41 | 00-40 | 00-40 | 00-39 |
| 53 00             | 00-52           | 00-50 | 00-49 | 00-48 | 00-47 | 00-46 | 00-45 | 00-44 | 00-44 | 00-43 | 00-42 | 00-41 | 00-40 | 00-40 | 00-39 | 00-38 | 00-38 |
| 54 00             | 00-50           | 00-49 | 00-48 | 00-47 | 00-46 | 00-45 | 00-44 | 00-43 | 00-42 | 00-41 | 00-41 | 00-40 | 00-39 | 00-38 | 00-38 | 00-37 | 00-37 |
| 55 00             | 00-48           | 00-47 | 00-46 | 00-45 | 00-44 | 00-43 | 00-42 | 00-41 | 00-40 | 00-40 | 00-39 | 00-38 | 00-38 | 00-37 | 00-36 | 00-36 | 00-35 |
| 56 00             | 00-46           | 00-45 | 00-44 | 00-43 | 00-42 | 00-41 | 00-41 | 00-40 | 00-39 | 00-38 | 00-38 | 00-37 | 00-36 | 00-36 | 00-35 | 00-34 | 00-34 |
| 57 00             | 00-45           | 00-44 | 00-43 | 00-42 | 00-41 | 00-40 | 00-39 | 00-38 | 00-38 | 00-37 | 00-36 | 00-36 | 00-35 | 00-34 | 00-34 | 00-33 | 00-33 |
| 58 00             | 00-43           | 00-42 | 00-41 | 00-40 | 00-39 | 00-38 | 00-38 | 00-37 | 00-36 | 00-36 | 00-35 | 00-34 | 00-34 | 00-33 | 00-32 | 00-32 | 00-31 |
| 59 00             | 00-41           | 00-40 | 00-39 | 00-39 | 00-38 | 00-37 | 00-36 | 00-35 | 00-35 | 00-34 | 00-33 | 00-33 | 00-32 | 00-32 | 00-31 | 00-31 | 00-30 |
| 60 00             | 00-40           | 00-39 | 00-38 | 00-37 | 00-36 | 00-35 | 00-35 | 00-34 | 00-33 | 00-33 | 00-32 | 00-32 | 00-31 | 00-30 | 00-30 | 00-29 | 00-29 |

Table 1b. Astronomic Refraction Corrected for Temperature (Mile)

TO BE SUBTRACTED FROM OBSERVED ALTITUDE OF SUN OR STAR

(Use values of observed altitude and temperature nearest the values tabulated as arguments.)

| Observed<br>altitude | Temperature °F. |       |       |       |       |       |       |       |       |       |       |       |      |      |      |      |      |
|----------------------|-----------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|------|------|
|                      | -60             | -50   | -40   | -30   | -20   | -10   | 0     | +10   | +20   | +30   | +40   | +50   | +60  | +70  | +80  | +90  | +100 |
| 0                    | 12.65           | 12.35 | 12.08 | 11.82 | 11.57 | 11.33 | 11.10 | 10.88 | 10.66 | 10.46 | 10.28 | 10.08 | 9.90 | 9.72 | 9.54 | 9.40 | 9.25 |
| 10                   | 9.33            | 9.60  | 9.39  | 9.18  | 8.99  | 8.80  | 8.63  | 8.45  | 8.29  | 8.13  | 7.97  | 7.83  | 7.69 | 7.55 | 7.42 | 7.30 | 7.19 |
| 20                   | 8.18            | 7.99  | 7.82  | 7.64  | 7.49  | 7.33  | 7.21  | 7.04  | 6.90  | 6.77  | 6.64  | 6.52  | 6.40 | 6.28 | 6.17 | 6.08 | 5.98 |
| 30                   | 6.94            | 6.73  | 6.53  | 6.49  | 6.35  | 6.22  | 6.09  | 5.97  | 5.85  | 5.74  | 5.63  | 5.53  | 5.43 | 5.33 | 5.24 | 5.16 | 5.08 |
| 40                   | 5.99            | 5.85  | 5.72  | 5.60  | 5.48  | 5.36  | 5.26  | 5.15  | 5.05  | 4.95  | 4.86  | 4.77  | 4.69 | 4.60 | 4.52 | 4.45 | 4.38 |
| 50                   | 5.24            | 5.11  | 5.00  | 4.89  | 4.79  | 4.69  | 4.60  | 4.50  | 4.42  | 4.33  | 4.25  | 4.17  | 4.10 | 4.02 | 3.95 | 3.89 | 3.83 |
| 60                   | 4.64            | 4.53  | 4.43  | 4.33  | 4.24  | 4.15  | 4.07  | 3.99  | 3.91  | 3.84  | 3.76  | 3.70  | 3.63 | 3.56 | 3.50 | 3.45 | 3.39 |
| 70                   | 4.15            | 4.05  | 3.96  | 3.88  | 3.80  | 3.72  | 3.64  | 3.57  | 3.50  | 3.43  | 3.37  | 3.31  | 3.25 | 3.19 | 3.13 | 3.08 | 3.03 |
| 80                   | 3.75            | 3.66  | 3.58  | 3.50  | 3.43  | 3.35  | 3.29  | 3.22  | 3.16  | 3.10  | 3.04  | 2.99  | 2.93 | 2.88 | 2.83 | 2.78 | 2.74 |
| 90                   | 3.41            | 3.33  | 3.26  | 3.19  | 3.12  | 3.06  | 2.99  | 2.93  | 2.88  | 2.82  | 2.77  | 2.72  | 2.67 | 2.62 | 2.57 | 2.53 | 2.46 |
| 100                  | 3.13            | 3.05  | 2.99  | 2.92  | 2.86  | 2.80  | 2.74  | 2.69  | 2.64  | 2.59  | 2.54  | 2.49  | 2.45 | 2.40 | 2.36 | 2.32 | 2.28 |
| 110                  | 2.88            | 2.81  | 2.75  | 2.69  | 2.64  | 2.58  | 2.53  | 2.48  | 2.43  | 2.38  | 2.34  | 2.30  | 2.25 | 2.21 | 2.17 | 2.14 | 2.11 |
| 120                  | 2.67            | 2.61  | 2.55  | 2.49  | 2.44  | 2.39  | 2.34  | 2.30  | 2.25  | 2.21  | 2.17  | 2.13  | 2.09 | 2.05 | 2.01 | 1.98 | 1.95 |
| 130                  | 2.49            | 2.43  | 2.37  | 2.32  | 2.27  | 2.22  | 2.18  | 2.14  | 2.10  | 2.06  | 2.02  | 1.98  | 1.94 | 1.91 | 1.88 | 1.85 | 1.82 |
| 140                  | 2.32            | 2.27  | 2.22  | 2.17  | 2.13  | 2.08  | 2.04  | 2.00  | 1.96  | 1.92  | 1.88  | 1.85  | 1.82 | 1.79 | 1.75 | 1.73 | 1.70 |
| 150                  | 2.13            | 2.13  | 2.08  | 2.04  | 2.00  | 1.95  | 1.91  | 1.88  | 1.84  | 1.80  | 1.77  | 1.74  | 1.71 | 1.68 | 1.65 | 1.62 | 1.59 |
| 160                  | 2.05            | 2.00  | 1.96  | 1.92  | 1.88  | 1.84  | 1.80  | 1.77  | 1.73  | 1.70  | 1.67  | 1.64  | 1.61 | 1.58 | 1.55 | 1.53 | 1.50 |
| 170                  | 1.94            | 1.89  | 1.85  | 1.81  | 1.77  | 1.74  | 1.70  | 1.67  | 1.64  | 1.60  | 1.57  | 1.55  | 1.52 | 1.49 | 1.46 | 1.44 | 1.42 |
| 180                  | 1.84            | 1.79  | 1.75  | 1.72  | 1.68  | 1.64  | 1.61  | 1.58  | 1.55  | 1.52  | 1.49  | 1.46  | 1.44 | 1.41 | 1.39 | 1.36 | 1.34 |
| 190                  | 1.74            | 1.70  | 1.67  | 1.63  | 1.59  | 1.56  | 1.53  | 1.50  | 1.47  | 1.44  | 1.41  | 1.39  | 1.36 | 1.34 | 1.32 | 1.29 | 1.27 |
| 200                  | 1.66            | 1.62  | 1.58  | 1.55  | 1.52  | 1.49  | 1.46  | 1.43  | 1.40  | 1.37  | 1.35  | 1.32  | 1.30 | 1.27 | 1.25 | 1.23 | 1.21 |
| 210                  | 1.58            | 1.54  | 1.51  | 1.48  | 1.45  | 1.42  | 1.39  | 1.36  | 1.33  | 1.31  | 1.28  | 1.26  | 1.24 | 1.22 | 1.19 | 1.18 | 1.16 |
| 220                  | 1.51            | 1.48  | 1.44  | 1.41  | 1.38  | 1.35  | 1.33  | 1.30  | 1.27  | 1.25  | 1.23  | 1.20  | 1.18 | 1.16 | 1.14 | 1.12 | 1.10 |
| 230                  | 1.45            | 1.41  | 1.38  | 1.35  | 1.32  | 1.29  | 1.27  | 1.25  | 1.22  | 1.20  | 1.17  | 1.15  | 1.13 | 1.11 | 1.09 | 1.07 | 1.06 |
| 240                  | 1.39            | 1.35  | 1.32  | 1.29  | 1.27  | 1.24  | 1.22  | 1.19  | 1.17  | 1.15  | 1.12  | 1.10  | 1.08 | 1.06 | 1.05 | 1.03 | 1.01 |
| 250                  | 1.33            | 1.30  | 1.27  | 1.24  | 1.22  | 1.19  | 1.17  | 1.14  | 1.12  | 1.10  | 1.08  | 1.06  | 1.04 | 1.02 | 1.00 | 0.99 | 0.97 |
| 260                  | 1.28            | 1.25  | 1.22  | 1.19  | 1.17  | 1.14  | 1.12  | 1.10  | 1.08  | 1.06  | 1.04  | 1.02  | 1.00 | 0.98 | 0.96 | 0.95 | 0.93 |
| 270                  | 1.23            | 1.20  | 1.18  | 1.15  | 1.13  | 1.10  | 1.08  | 1.06  | 1.04  | 1.02  | 0.99  | 0.98  | 0.96 | 0.95 | 0.93 | 0.91 | 0.90 |
| 280                  | 1.19            | 1.16  | 1.13  | 1.11  | 1.09  | 1.06  | 1.04  | 1.02  | 1.00  | 0.98  | 0.96  | 0.94  | 0.93 | 0.91 | 0.90 | 0.88 | 0.87 |
| 290                  | 1.14            | 1.12  | 1.09  | 1.07  | 1.05  | 1.02  | 1.00  | 0.98  | 0.96  | 0.95  | 0.93  | 0.91  | 0.89 | 0.88 | 0.86 | 0.85 | 0.84 |
| 300                  | 1.10            | 1.08  | 1.06  | 1.03  | 1.01  | 0.99  | 0.97  | 0.95  | 0.93  | 0.91  | 0.90  | 0.88  | 0.86 | 0.85 | 0.83 | 0.82 | 0.81 |
| 310                  | 1.07            | 1.04  | 1.02  | 1.00  | 0.98  | 0.96  | 0.94  | 0.92  | 0.90  | 0.88  | 0.87  | 0.85  | 0.84 | 0.82 | 0.81 | 0.79 | 0.78 |
| 320                  | 1.03            | 1.01  | 0.99  | 0.96  | 0.94  | 0.92  | 0.91  | 0.89  | 0.87  | 0.85  | 0.84  | 0.82  | 0.81 | 0.79 | 0.78 | 0.77 | 0.75 |
| 330                  | 1.00            | 0.98  | 0.96  | 0.93  | 0.92  | 0.90  | 0.88  | 0.86  | 0.84  | 0.83  | 0.81  | 0.80  | 0.78 | 0.77 | 0.75 | 0.74 | 0.73 |
| 340                  | 0.97            | 0.95  | 0.93  | 0.91  | 0.89  | 0.87  | 0.85  | 0.83  | 0.82  | 0.80  | 0.79  | 0.77  | 0.76 | 0.74 | 0.73 | 0.72 | 0.71 |

Table 1b. Astronomic Refraction Corrected for Temperature (Mils)—Continued

| Observed altitude | Temperature °F. |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-------------------|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                   | -30             | -20  | -10  | 0    | +10  | +20  | +30  | +40  | +50  | +60  | +70  | +80  | +90  | +100 | +110 | +120 | +130 |
| 350               | 0.94            | 0.92 | 0.90 | 0.88 | 0.86 | 0.84 | 0.82 | 0.81 | 0.79 | 0.78 | 0.76 | 0.75 | 0.74 | 0.72 | 0.71 | 0.70 | 0.69 |
| 360               | 0.91            | 0.89 | 0.87 | 0.85 | 0.83 | 0.82 | 0.80 | 0.78 | 0.77 | 0.75 | 0.74 | 0.73 | 0.71 | 0.70 | 0.69 | 0.68 | 0.67 |
| 370               | 0.89            | 0.86 | 0.85 | 0.83 | 0.81 | 0.79 | 0.78 | 0.76 | 0.75 | 0.73 | 0.72 | 0.71 | 0.69 | 0.68 | 0.67 | 0.66 | 0.65 |
| 380               | 0.86            | 0.84 | 0.82 | 0.80 | 0.79 | 0.77 | 0.76 | 0.74 | 0.73 | 0.71 | 0.70 | 0.69 | 0.67 | 0.66 | 0.65 | 0.64 | 0.63 |
| 390               | 0.84            | 0.82 | 0.80 | 0.78 | 0.77 | 0.75 | 0.73 | 0.72 | 0.71 | 0.69 | 0.68 | 0.67 | 0.65 | 0.64 | 0.63 | 0.62 | 0.61 |
| 400               | 0.81            | 0.79 | 0.78 | 0.76 | 0.74 | 0.73 | 0.71 | 0.70 | 0.69 | 0.67 | 0.66 | 0.65 | 0.64 | 0.62 | 0.61 | 0.60 | 0.59 |
| 410               | 0.79            | 0.77 | 0.76 | 0.74 | 0.72 | 0.71 | 0.70 | 0.68 | 0.67 | 0.65 | 0.64 | 0.63 | 0.62 | 0.61 | 0.60 | 0.59 | 0.58 |
| 420               | 0.77            | 0.75 | 0.74 | 0.72 | 0.71 | 0.69 | 0.68 | 0.66 | 0.65 | 0.64 | 0.63 | 0.61 | 0.60 | 0.59 | 0.58 | 0.57 | 0.56 |
| 430               | 0.75            | 0.73 | 0.72 | 0.70 | 0.69 | 0.67 | 0.66 | 0.65 | 0.63 | 0.62 | 0.61 | 0.60 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 |
| 440               | 0.73            | 0.71 | 0.70 | 0.68 | 0.67 | 0.66 | 0.64 | 0.63 | 0.62 | 0.61 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.54 | 0.54 |
| 450               | 0.71            | 0.70 | 0.68 | 0.67 | 0.65 | 0.64 | 0.63 | 0.61 | 0.60 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.54 | 0.53 | 0.52 |
| 460               | 0.70            | 0.68 | 0.66 | 0.65 | 0.64 | 0.62 | 0.61 | 0.60 | 0.59 | 0.58 | 0.56 | 0.55 | 0.54 | 0.53 | 0.53 | 0.52 | 0.51 |
| 470               | 0.68            | 0.66 | 0.65 | 0.64 | 0.62 | 0.61 | 0.60 | 0.58 | 0.57 | 0.56 | 0.55 | 0.54 | 0.53 | 0.52 | 0.51 | 0.50 | 0.50 |
| 480               | 0.66            | 0.65 | 0.63 | 0.62 | 0.61 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.54 | 0.53 | 0.52 | 0.51 | 0.50 | 0.49 | 0.48 |
| 490               | 0.65            | 0.63 | 0.62 | 0.60 | 0.59 | 0.58 | 0.57 | 0.56 | 0.55 | 0.54 | 0.52 | 0.52 | 0.51 | 0.50 | 0.49 | 0.48 | 0.47 |
| 500               | 0.63            | 0.62 | 0.60 | 0.59 | 0.58 | 0.57 | 0.55 | 0.54 | 0.53 | 0.52 | 0.51 | 0.50 | 0.49 | 0.49 | 0.48 | 0.47 | 0.46 |
| 510               | 0.62            | 0.62 | 0.59 | 0.58 | 0.56 | 0.55 | 0.54 | 0.53 | 0.52 | 0.51 | 0.50 | 0.49 | 0.48 | 0.47 | 0.47 | 0.46 | 0.45 |
| 520               | 0.60            | 0.59 | 0.58 | 0.56 | 0.55 | 0.54 | 0.53 | 0.52 | 0.51 | 0.50 | 0.49 | 0.48 | 0.47 | 0.46 | 0.46 | 0.45 | 0.44 |
| 530               | 0.59            | 0.58 | 0.56 | 0.55 | 0.54 | 0.53 | 0.52 | 0.51 | 0.50 | 0.49 | 0.48 | 0.47 | 0.46 | 0.45 | 0.45 | 0.44 | 0.43 |
| 540               | 0.58            | 0.56 | 0.55 | 0.54 | 0.53 | 0.52 | 0.51 | 0.50 | 0.49 | 0.48 | 0.47 | 0.46 | 0.45 | 0.44 | 0.43 | 0.43 | 0.42 |
| 550               | 0.56            | 0.55 | 0.54 | 0.53 | 0.52 | 0.51 | 0.50 | 0.49 | 0.48 | 0.47 | 0.46 | 0.45 | 0.44 | 0.43 | 0.42 | 0.42 | 0.41 |
| 560               | 0.55            | 0.54 | 0.53 | 0.52 | 0.50 | 0.49 | 0.48 | 0.47 | 0.47 | 0.46 | 0.45 | 0.44 | 0.43 | 0.42 | 0.42 | 0.41 | 0.40 |
| 570               | 0.54            | 0.53 | 0.52 | 0.50 | 0.49 | 0.48 | 0.47 | 0.46 | 0.46 | 0.45 | 0.44 | 0.43 | 0.42 | 0.41 | 0.41 | 0.40 | 0.39 |
| 580               | 0.53            | 0.52 | 0.50 | 0.49 | 0.48 | 0.47 | 0.46 | 0.45 | 0.45 | 0.44 | 0.43 | 0.42 | 0.41 | 0.41 | 0.40 | 0.39 | 0.39 |
| 590               | 0.52            | 0.50 | 0.49 | 0.48 | 0.47 | 0.46 | 0.45 | 0.44 | 0.44 | 0.43 | 0.42 | 0.41 | 0.40 | 0.40 | 0.39 | 0.38 | 0.38 |
| 600               | 0.51            | 0.49 | 0.48 | 0.47 | 0.46 | 0.45 | 0.44 | 0.44 | 0.43 | 0.42 | 0.41 | 0.40 | 0.40 | 0.39 | 0.38 | 0.38 | 0.37 |
| 610               | 0.50            | 0.48 | 0.47 | 0.46 | 0.45 | 0.44 | 0.44 | 0.43 | 0.42 | 0.41 | 0.40 | 0.40 | 0.39 | 0.38 | 0.37 | 0.37 | 0.36 |
| 620               | 0.49            | 0.47 | 0.46 | 0.45 | 0.44 | 0.43 | 0.43 | 0.42 | 0.41 | 0.40 | 0.39 | 0.39 | 0.38 | 0.37 | 0.37 | 0.36 | 0.35 |
| 630               | 0.48            | 0.46 | 0.45 | 0.44 | 0.44 | 0.43 | 0.42 | 0.41 | 0.40 | 0.39 | 0.39 | 0.38 | 0.37 | 0.37 | 0.36 | 0.35 | 0.35 |
| 640               | 0.47            | 0.45 | 0.44 | 0.43 | 0.43 | 0.42 | 0.41 | 0.40 | 0.39 | 0.39 | 0.38 | 0.37 | 0.36 | 0.36 | 0.35 | 0.35 | 0.34 |
| 650               | 0.46            | 0.45 | 0.44 | 0.43 | 0.42 | 0.41 | 0.40 | 0.39 | 0.38 | 0.38 | 0.37 | 0.36 | 0.36 | 0.35 | 0.34 | 0.34 | 0.33 |
| 660               | 0.45            | 0.44 | 0.43 | 0.42 | 0.41 | 0.40 | 0.39 | 0.38 | 0.38 | 0.37 | 0.36 | 0.36 | 0.35 | 0.34 | 0.34 | 0.33 | 0.33 |
| 670               | 0.44            | 0.43 | 0.42 | 0.41 | 0.40 | 0.39 | 0.38 | 0.38 | 0.37 | 0.36 | 0.36 | 0.35 | 0.34 | 0.34 | 0.33 | 0.33 | 0.32 |
| 680               | 0.43            | 0.42 | 0.41 | 0.40 | 0.39 | 0.39 | 0.38 | 0.37 | 0.36 | 0.36 | 0.35 | 0.34 | 0.34 | 0.33 | 0.32 | 0.32 | 0.31 |
| 690               | 0.42            | 0.41 | 0.40 | 0.39 | 0.39 | 0.38 | 0.37 | 0.36 | 0.36 | 0.35 | 0.34 | 0.34 | 0.33 | 0.32 | 0.32 | 0.31 | 0.31 |
| 700               | 0.41            | 0.40 | 0.39 | 0.39 | 0.38 | 0.37 | 0.36 | 0.36 | 0.35 | 0.34 | 0.33 | 0.33 | 0.32 | 0.32 | 0.31 | 0.31 | 0.30 |
| 710               | 0.40            | 0.40 | 0.39 | 0.38 | 0.37 | 0.36 | 0.36 | 0.35 | 0.34 | 0.33 | 0.33 | 0.32 | 0.32 | 0.31 | 0.31 | 0.30 | 0.30 |
| 720               | 0.40            | 0.39 | 0.38 | 0.37 | 0.36 | 0.36 | 0.35 | 0.34 | 0.33 | 0.33 | 0.32 | 0.32 | 0.31 | 0.30 | 0.30 | 0.29 | 0.29 |
| 730               | 0.39            | 0.38 | 0.37 | 0.36 | 0.36 | 0.35 | 0.34 | 0.33 | 0.33 | 0.32 | 0.31 | 0.31 | 0.30 | 0.30 | 0.29 | 0.29 | 0.28 |
| 740               | 0.38            | 0.37 | 0.36 | 0.36 | 0.35 | 0.34 | 0.33 | 0.33 | 0.32 | 0.32 | 0.31 | 0.30 | 0.30 | 0.29 | 0.29 | 0.28 | 0.28 |
| 750               | 0.37            | 0.36 | 0.36 | 0.35 | 0.34 | 0.33 | 0.33 | 0.32 | 0.32 | 0.31 | 0.30 | 0.30 | 0.29 | 0.29 | 0.28 | 0.28 | 0.27 |

Table 1b. Astronomic Refraction Corrected for Temperature (Mils)—Continued

| Observed altitude | Temperature °F. |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-------------------|-----------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|                   | -30             | -20  | -10  | 0    | +10  | +20  | +30  | +40  | +50  | +60  | +70  | +80  | +90  | +100 | +110 | +120 | +130 |
| 760               | 0.37            | 0.36 | 0.35 | 0.34 | 0.34 | 0.33 | 0.32 | 0.32 | 0.31 | 0.30 | 0.30 | 0.29 | 0.29 | 0.28 | 0.28 | 0.27 | 0.27 |
| 770               | 0.36            | 0.35 | 0.34 | 0.34 | 0.33 | 0.32 | 0.32 | 0.31 | 0.30 | 0.30 | 0.29 | 0.29 | 0.28 | 0.28 | 0.27 | 0.27 | 0.26 |
| 780               | 0.35            | 0.34 | 0.34 | 0.33 | 0.32 | 0.32 | 0.31 | 0.30 | 0.30 | 0.29 | 0.29 | 0.28 | 0.28 | 0.27 | 0.27 | 0.26 | 0.26 |
| 790               | 0.35            | 0.34 | 0.33 | 0.32 | 0.32 | 0.31 | 0.30 | 0.30 | 0.29 | 0.29 | 0.28 | 0.28 | 0.27 | 0.27 | 0.26 | 0.26 | 0.25 |
| 800               | 0.34            | 0.33 | 0.32 | 0.32 | 0.31 | 0.30 | 0.30 | 0.29 | 0.29 | 0.28 | 0.28 | 0.27 | 0.27 | 0.26 | 0.26 | 0.25 | 0.25 |
| 810               | 0.33            | 0.32 | 0.32 | 0.31 | 0.30 | 0.30 | 0.29 | 0.29 | 0.28 | 0.27 | 0.27 | 0.26 | 0.26 | 0.26 | 0.25 | 0.25 | 0.24 |
| 820               | 0.33            | 0.32 | 0.31 | 0.30 | 0.30 | 0.29 | 0.29 | 0.28 | 0.27 | 0.27 | 0.26 | 0.26 | 0.25 | 0.25 | 0.25 | 0.24 | 0.24 |
| 830               | 0.32            | 0.31 | 0.31 | 0.30 | 0.29 | 0.29 | 0.28 | 0.28 | 0.27 | 0.26 | 0.26 | 0.25 | 0.25 | 0.25 | 0.24 | 0.24 | 0.23 |
| 840               | 0.31            | 0.31 | 0.30 | 0.29 | 0.29 | 0.28 | 0.27 | 0.27 | 0.26 | 0.26 | 0.25 | 0.25 | 0.24 | 0.24 | 0.24 | 0.23 | 0.23 |
| 850               | 0.31            | 0.30 | 0.29 | 0.29 | 0.28 | 0.27 | 0.27 | 0.26 | 0.26 | 0.25 | 0.25 | 0.24 | 0.24 | 0.24 | 0.23 | 0.23 | 0.22 |
| 860               | 0.30            | 0.29 | 0.29 | 0.28 | 0.28 | 0.27 | 0.26 | 0.26 | 0.25 | 0.25 | 0.24 | 0.24 | 0.24 | 0.23 | 0.23 | 0.22 | 0.22 |
| 870               | 0.30            | 0.29 | 0.28 | 0.28 | 0.27 | 0.26 | 0.26 | 0.25 | 0.25 | 0.24 | 0.24 | 0.24 | 0.23 | 0.23 | 0.22 | 0.22 | 0.22 |
| 880               | 0.29            | 0.28 | 0.28 | 0.27 | 0.26 | 0.25 | 0.25 | 0.25 | 0.24 | 0.24 | 0.23 | 0.23 | 0.23 | 0.22 | 0.22 | 0.21 | 0.21 |
| 890               | 0.28            | 0.28 | 0.27 | 0.27 | 0.26 | 0.25 | 0.25 | 0.24 | 0.24 | 0.23 | 0.23 | 0.23 | 0.22 | 0.22 | 0.21 | 0.21 | 0.21 |
| 900               | 0.28            | 0.27 | 0.27 | 0.26 | 0.25 | 0.25 | 0.24 | 0.24 | 0.23 | 0.23 | 0.23 | 0.22 | 0.22 | 0.21 | 0.21 | 0.21 | 0.20 |
| 910               | 0.27            | 0.27 | 0.26 | 0.25 | 0.25 | 0.24 | 0.24 | 0.23 | 0.23 | 0.23 | 0.22 | 0.22 | 0.21 | 0.21 | 0.21 | 0.20 | 0.20 |
| 920               | 0.27            | 0.26 | 0.26 | 0.25 | 0.24 | 0.24 | 0.23 | 0.23 | 0.23 | 0.22 | 0.22 | 0.21 | 0.21 | 0.21 | 0.20 | 0.20 | 0.20 |
| 930               | 0.26            | 0.26 | 0.25 | 0.24 | 0.24 | 0.23 | 0.23 | 0.23 | 0.22 | 0.22 | 0.21 | 0.21 | 0.20 | 0.20 | 0.20 | 0.19 | 0.19 |
| 940               | 0.26            | 0.25 | 0.25 | 0.24 | 0.24 | 0.23 | 0.23 | 0.22 | 0.22 | 0.21 | 0.21 | 0.20 | 0.20 | 0.20 | 0.19 | 0.19 | 0.19 |
| 950               | 0.25            | 0.25 | 0.24 | 0.23 | 0.23 | 0.22 | 0.22 | 0.22 | 0.21 | 0.21 | 0.20 | 0.20 | 0.20 | 0.19 | 0.19 | 0.19 | 0.18 |
| 960               | 0.25            | 0.24 | 0.24 | 0.23 | 0.23 | 0.22 | 0.22 | 0.21 | 0.21 | 0.20 | 0.20 | 0.20 | 0.19 | 0.19 | 0.19 | 0.18 | 0.18 |
| 970               | 0.24            | 0.24 | 0.23 | 0.23 | 0.22 | 0.22 | 0.21 | 0.21 | 0.20 | 0.20 | 0.20 | 0.19 | 0.19 | 0.19 | 0.18 | 0.18 | 0.18 |
| 980               | 0.24            | 0.23 | 0.23 | 0.22 | 0.22 | 0.21 | 0.21 | 0.20 | 0.20 | 0.20 | 0.19 | 0.19 | 0.19 | 0.18 | 0.18 | 0.18 | 0.17 |
| 990               | 0.23            | 0.23 | 0.22 | 0.22 | 0.21 | 0.21 | 0.20 | 0.20 | 0.20 | 0.19 | 0.19 | 0.18 | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 |
| 1000              | 0.23            | 0.22 | 0.22 | 0.21 | 0.21 | 0.20 | 0.20 | 0.19 | 0.19 | 0.19 | 0.18 | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 | 0.17 |
| 1010              | 0.22            | 0.22 | 0.21 | 0.21 | 0.20 | 0.20 | 0.19 | 0.19 | 0.19 | 0.18 | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 |
| 1020              | 0.22            | 0.21 | 0.21 | 0.20 | 0.20 | 0.19 | 0.19 | 0.19 | 0.18 | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 | 0.16 |
| 1030              | 0.21            | 0.21 | 0.20 | 0.20 | 0.19 | 0.19 | 0.19 | 0.18 | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 | 0.16 | 0.16 |
| 1040              | 0.21            | 0.20 | 0.20 | 0.19 | 0.19 | 0.19 | 0.18 | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 | 0.16 | 0.15 | 0.15 |
| 1050              | 0.20            | 0.20 | 0.19 | 0.19 | 0.19 | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 | 0.16 | 0.15 | 0.15 | 0.15 | 0.15 |
| 1060              | 0.20            | 0.19 | 0.19 | 0.19 | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 | 0.16 | 0.16 | 0.15 | 0.15 | 0.15 | 0.15 |
| 1070              | 0.19            | 0.19 | 0.19 | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 | 0.16 | 0.15 | 0.15 | 0.15 | 0.15 | 0.14 | 0.14 |
| 1080              | 0.19            | 0.19 | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 | 0.16 | 0.15 | 0.15 | 0.15 | 0.15 | 0.14 | 0.14 | 0.14 |
| 1090              | 0.19            | 0.18 | 0.18 | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 | 0.16 | 0.15 | 0.15 | 0.15 | 0.15 | 0.14 | 0.14 | 0.14 | 0.14 |
| 1100              | 0.18            | 0.18 | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 | 0.16 | 0.15 | 0.15 | 0.15 | 0.14 | 0.14 | 0.14 | 0.14 | 0.13 | 0.13 |
| 1110              | 0.18            | 0.17 | 0.17 | 0.17 | 0.16 | 0.16 | 0.16 | 0.15 | 0.15 | 0.15 | 0.14 | 0.14 | 0.14 | 0.14 | 0.13 | 0.13 | 0.13 |
| 1120              | 0.17            | 0.17 | 0.17 | 0.16 | 0.16 | 0.15 | 0.15 | 0.15 | 0.15 | 0.14 | 0.14 | 0.14 | 0.14 | 0.13 | 0.13 | 0.13 | 0.13 |
| 1130              | 0.17            | 0.16 | 0.16 | 0.16 | 0.15 | 0.15 | 0.15 | 0.15 | 0.14 | 0.14 | 0.14 | 0.13 | 0.13 | 0.13 | 0.13 | 0.13 | 0.12 |
| 1140              | 0.16            | 0.16 | 0.16 | 0.15 | 0.15 | 0.15 | 0.14 | 0.14 | 0.14 | 0.14 | 0.13 | 0.13 | 0.13 | 0.13 | 0.12 | 0.12 | 0.12 |
| 1150              | 0.16            | 0.16 | 0.15 | 0.15 | 0.15 | 0.14 | 0.14 | 0.14 | 0.14 | 0.13 | 0.13 | 0.13 | 0.13 | 0.12 | 0.12 | 0.12 | 0.12 |
| 1160              | 0.16            | 0.15 | 0.15 | 0.15 | 0.14 | 0.14 | 0.14 | 0.13 | 0.13 | 0.13 | 0.13 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.11 |
| 1170              | 0.15            | 0.15 | 0.15 | 0.14 | 0.14 | 0.14 | 0.13 | 0.13 | 0.13 | 0.13 | 0.12 | 0.12 | 0.12 | 0.12 | 0.11 | 0.11 | 0.11 |
| 1180              | 0.15            | 0.15 | 0.14 | 0.14 | 0.14 | 0.13 | 0.13 | 0.13 | 0.13 | 0.12 | 0.12 | 0.12 | 0.12 | 0.11 | 0.11 | 0.11 | 0.11 |
| 1190              | 0.14            | 0.14 | 0.14 | 0.14 | 0.13 | 0.13 | 0.13 | 0.12 | 0.12 | 0.12 | 0.12 | 0.12 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 |
| 1200              | 0.14            | 0.14 | 0.13 | 0.13 | 0.13 | 0.13 | 0.12 | 0.12 | 0.12 | 0.12 | 0.11 | 0.11 | 0.11 | 0.11 | 0.11 | 0.10 | 0.10 |

*Table 1a. Pressure Correction Factor,  $C_B$*   
 Apply to values in tables 1a or 1b

| Barometer |           | $C_B$ | Barometer |           | $C_B$ | Barometer |           | $C_B$ |
|-----------|-----------|-------|-----------|-----------|-------|-----------|-----------|-------|
| Inches    | Millibars |       | Inches    | Millibars |       | Inches    | Millibars |       |
| 20.0      | 677       | 0.670 | 23.8      | 806       | 0.796 | 27.4      | 928       | 0.916 |
| 20.1      | 681       | 0.673 | 23.9      | 809       | 0.799 | 27.5      | 931       | 0.920 |
| 20.2      | 684       | 0.676 | 24.0      | 813       | 0.803 | 27.6      | 935       | 0.923 |
| 20.3      | 687       | 0.679 | 24.1      | 816       | 0.806 | 27.7      | 938       | 0.926 |
| 20.4      | 691       | 0.682 | 24.2      | 820       | 0.809 | 27.8      | 941       | 0.929 |
| 20.5      | 694       | 0.685 | 24.3      | 823       | 0.813 | 27.9      | 945       | 0.933 |
| 20.6      | 698       | 0.688 | 24.4      | 826       | 0.816 | 28.0      | 948       | 0.936 |
| 20.7      | 701       | 0.692 | 24.5      | 830       | 0.820 | 28.1      | 952       | 0.939 |
| 20.8      | 704       | 0.696 | 24.6      | 833       | 0.823 | 28.2      | 955       | 0.942 |
| 20.9      | 708       | 0.699 | 24.7      | 836       | 0.826 | 28.3      | 958       | 0.946 |
| 21.0      | 711       | 0.703 | 24.8      | 840       | 0.829 | 28.4      | 962       | 0.949 |
| 21.1      | 715       | 0.706 | 24.9      | 843       | 0.832 | 28.5      | 965       | 0.953 |
| 21.2      | 718       | 0.709 | 25.0      | 847       | 0.835 | 28.6      | 969       | 0.956 |
| 21.3      | 721       | 0.712 | 25.1      | 850       | 0.838 | 28.7      | 972       | 0.959 |
| 21.4      | 725       | 0.716 | 25.2      | 853       | 0.842 | 28.8      | 975       | 0.963 |
| 21.5      | 728       | 0.719 | 25.3      | 857       | 0.846 | 28.9      | 979       | 0.966 |
| 21.6      | 731       | 0.722 | 25.4      | 860       | 0.849 | 29.0      | 982       | 0.970 |
| 21.7      | 735       | 0.725 | 25.5      | 864       | 0.853 | 29.1      | 985       | 0.973 |
| 21.8      | 738       | 0.729 | 25.6      | 867       | 0.856 | 29.2      | 989       | 0.976 |
| 21.9      | 742       | 0.732 | 25.7      | 870       | 0.859 | 29.3      | 992       | 0.979 |
| 22.0      | 745       | 0.735 | 25.8      | 874       | 0.862 | 29.4      | 996       | 0.983 |
| 22.1      | 748       | 0.739 | 25.9      | 877       | 0.866 | 29.5      | 999       | 0.986 |
| 22.2      | 752       | 0.742 | 26.0      | 880       | 0.869 | 29.6      | 1002      | 0.989 |
| 22.3      | 755       | 0.746 | 26.1      | 884       | 0.872 | 29.7      | 1006      | 0.992 |
| 22.4      | 759       | 0.749 | 26.2      | 887       | 0.875 | 29.8      | 1009      | 0.996 |
| 22.5      | 762       | 0.752 | 26.3      | 891       | 0.879 | 29.9      | 1013      | 0.999 |
| 22.6      | 765       | 0.755 | 26.4      | 894       | 0.882 | 30.0      | 1016      | 1.003 |
| 22.7      | 769       | 0.759 | 26.5      | 897       | 0.885 | 30.1      | 1019      | 1.007 |
| 22.8      | 772       | 0.762 | 26.6      | 901       | 0.889 | 30.2      | 1023      | 1.010 |
| 22.9      | 775       | 0.766 | 26.7      | 904       | 0.892 | 30.3      | 1026      | 1.013 |
| 23.0      | 779       | 0.770 | 26.8      | 908       | 0.896 | 30.4      | 1029      | 1.016 |
| 23.1      | 782       | 0.773 | 26.9      | 911       | 0.899 | 30.5      | 1033      | 1.020 |
| 23.2      | 786       | 0.776 | 27.0      | 914       | 0.902 | 30.6      | 1036      | 1.023 |
| 23.3      | 789       | 0.779 | 27.1      | 918       | 0.905 | 30.7      | 1040      | 1.026 |
| 23.4      | 792       | 0.783 | 27.2      | 921       | 0.909 | 30.8      | 1043      | 1.029 |
| 23.5      | 796       | 0.786 | 27.3      | 924       | 0.912 | 30.9      | 1046      | 1.033 |
| 23.6      | 799       | 0.789 |           |           |       | 31.0      | 1050      | 1.036 |
| 23.7      | 803       | 0.792 |           |           |       |           |           |       |

Note. Omit Pressure Correction Factor for artillery surveys of fourth-order (1:3000) or lesser accuracies.

Table 2. Sun, 1976 for Zero Hours Universal Time (GMT)

| Greenwich<br>date | Apparent declination |    |    |                          |                           | Equation of time |      |                          | Sidereal time |     |      |
|-------------------|----------------------|----|----|--------------------------|---------------------------|------------------|------|--------------------------|---------------|-----|------|
|                   | Degrees              |    |    | Mils                     |                           | Min              | Sec  | Daily<br>change<br>(sec) | Hr            | Min | Sec  |
|                   | °                    | '  | "  | Daily<br>change<br>(sec) | Daily<br>change<br>(mils) |                  |      |                          |               |     |      |
| JAN 0 WE          | -23                  | 9  | 24 |                          | - 411.68                  | - 2              | 33.0 |                          | 6             | 35  | 12.1 |
| 1 TH              | -23                  | 5  | 11 | + 253                    | + 1.26                    | - 3              | 1.8  | - 28.9                   | 6             | 39  | 8.7  |
| 2 FR              | -23                  | 0  | 30 | + 281                    | + 1.38                    | - 3              | 30.5 | - 28.6                   | 6             | 43  | 5.3  |
| 3 SA              | -22                  | 55 | 21 | + 309                    | + 1.53                    | - 3              | 58.8 | - 28.3                   | 6             | 47  | 1.8  |
| 4 SU              | -22                  | 49 | 45 | + 336                    | + 1.66                    | - 4              | 26.7 | - 27.9                   | 6             | 50  | 58.4 |
| 5 MO              | -22                  | 43 | 42 | + 363                    | + 1.79                    | - 4              | 54.2 | - 27.5                   | 6             | 54  | 54.9 |
| 6 TU              | -22                  | 37 | 12 | + 390                    | + 1.93                    | - 5              | 21.3 | - 27.1                   | 6             | 58  | 51.5 |
| 7 WE              | -22                  | 30 | 15 | + 417                    | + 2.06                    | - 5              | 48.0 | - 26.7                   | 7             | 2   | 48.0 |
| 8 TH              | -22                  | 22 | 51 | + 444                    | + 2.19                    | - 6              | 14.2 | - 26.2                   | 7             | 6   | 44.6 |
| 9 FR              | -22                  | 15 | 1  | + 470                    | + 2.32                    | - 6              | 39.9 | - 25.7                   | 7             | 10  | 41.2 |
| 10 SA             | -22                  | 6  | 45 | + 496                    | + 2.45                    | - 7              | 5.1  | - 25.1                   | 7             | 14  | 37.7 |
| 11 SU             | -21                  | 58 | 2  | + 523                    | + 2.58                    | - 7              | 29.6 | - 24.6                   | 7             | 18  | 34.3 |
| 12 MO             | -21                  | 48 | 55 | + 547                    | + 2.71                    | - 7              | 53.7 | - 24.0                   | 7             | 22  | 30.8 |
| 13 TU             | -21                  | 39 | 21 | + 574                    | + 2.83                    | - 8              | 17.1 | - 23.4                   | 7             | 26  | 27.4 |
| 14 WE             | -21                  | 29 | 23 | + 598                    | + 2.95                    | - 8              | 39.8 | - 22.8                   | 7             | 30  | 23.9 |
| 15 TH             | -21                  | 19 | 0  | + 623                    | + 3.08                    | - 9              | 2.0  | - 22.1                   | 7             | 34  | 20.5 |
| 16 FR             | -21                  | 8  | 12 | + 648                    | + 3.20                    | - 9              | 23.4 | - 21.5                   | 7             | 38  | 17.1 |
| 17 SA             | -20                  | 57 | 0  | + 672                    | + 3.32                    | - 9              | 44.3 | - 20.8                   | 7             | 42  | 13.6 |
| 18 SU             | -20                  | 45 | 24 | + 696                    | + 3.43                    | - 10             | 4.3  | - 20.1                   | 7             | 46  | 10.2 |
| 19 MO             | -20                  | 33 | 24 | + 720                    | + 3.56                    | - 10             | 23.8 | - 19.4                   | 7             | 50  | 6.7  |
| 20 TU             | -20                  | 21 | 1  | + 743                    | + 3.67                    | - 10             | 42.4 | - 18.7                   | 7             | 54  | 3.3  |
| 21 WE             | -20                  | 8  | 15 | + 766                    | + 3.78                    | - 11             | 0.4  | - 18.0                   | 7             | 57  | 59.8 |
| 22 TH             | -19                  | 55 | 6  | + 789                    | + 3.90                    | - 11             | 17.7 | - 17.2                   | 8             | 1   | 56.4 |
| 23 FR             | -19                  | 41 | 35 | + 811                    | + 4.00                    | - 11             | 34.2 | - 16.5                   | 8             | 5   | 52.9 |
| 24 SA             | -19                  | 27 | 41 | + 834                    | + 4.12                    | - 11             | 49.9 | - 15.8                   | 8             | 9   | 49.5 |
| 25 SU             | -19                  | 13 | 26 | + 855                    | + 4.22                    | - 12             | 4.9  | - 15.0                   | 8             | 13  | 46.1 |
| 26 MO             | -18                  | 58 | 50 | + 876                    | + 4.33                    | - 12             | 19.1 | - 14.2                   | 8             | 17  | 42.6 |
| 27 TU             | -18                  | 43 | 53 | + 897                    | + 4.43                    | - 12             | 32.6 | - 13.4                   | 8             | 21  | 39.2 |
| 28 WE             | -18                  | 28 | 35 | + 918                    | + 4.53                    | - 12             | 45.3 | - 12.7                   | 8             | 25  | 35.7 |
| 29 TH             | -18                  | 12 | 57 | + 938                    | + 4.63                    | - 12             | 57.1 | - 11.9                   | 8             | 29  | 32.3 |
| 30 FR             | -17                  | 57 | 0  | + 957                    | + 4.73                    | - 13             | 8.2  | - 11.1                   | 8             | 33  | 28.9 |
| 31 SA             | -17                  | 40 | 43 | + 977                    | + 4.82                    | - 13             | 18.5 | - 10.3                   | 8             | 37  | 25.4 |
|                   |                      |    |    | + 995                    | + 4.92                    |                  |      | - 9.4                    |               |     |      |

**Table 2. Sun, 1976 for Zero Hours Universal Time (GMT) — Continued**

| Greenwich<br>date | Apparent declination |       |                          |          | Equation of time |      |                          | Sidereal time |     |      |
|-------------------|----------------------|-------|--------------------------|----------|------------------|------|--------------------------|---------------|-----|------|
|                   | Degrees              |       | Mils                     |          | Min              | Sec  | Daily<br>change<br>(sec) | Hr            | Min | Sec  |
|                   | °                    | ' "   | Daily<br>change<br>(sec) | Mils     |                  |      |                          |               |     |      |
| FEB 1 SU          | -17                  | 24 8  |                          | - 309.37 | -13              | 27.9 |                          | 8             | 41  | 22.0 |
|                   |                      |       | +1014                    | + 5.01   |                  |      | - 8.6                    |               |     |      |
| 2 MO              | -17                  | 7 14  |                          | - 304.36 | -13              | 36.5 |                          | 8             | 45  | 18.5 |
|                   |                      |       | +1032                    | + 5.09   |                  |      | - 7.8                    |               |     |      |
| 3 TU              | -16                  | 50 2  |                          | - 299.27 | -13              | 44.3 |                          | 8             | 49  | 15.1 |
|                   |                      |       | +1050                    | + 5.19   |                  |      | - 7.0                    |               |     |      |
| 4 WE              | -16                  | 32 32 |                          | - 294.08 | -13              | 51.3 |                          | 8             | 53  | 11.6 |
|                   |                      |       | +1067                    | + 5.27   |                  |      | - 6.1                    |               |     |      |
| 5 TH              | -16                  | 14 45 |                          | - 288.81 | -13              | 57.4 |                          | 8             | 57  | 8.2  |
|                   |                      |       | +1084                    | + 5.35   |                  |      | - 5.3                    |               |     |      |
| 6 FR              | -15                  | 56 41 |                          | - 283.46 | -14              | 2.7  |                          | 9             | 1   | 4.7  |
|                   |                      |       | +1100                    | + 5.43   |                  |      | - 4.5                    |               |     |      |
| 7 SA              | -15                  | 38 21 |                          | - 278.03 | -14              | 7.2  |                          | 9             | 5   | 1.3  |
|                   |                      |       | +1116                    | + 5.51   |                  |      | - 3.7                    |               |     |      |
| 8 SU              | -15                  | 19 45 |                          | - 272.52 | -14              | 10.9 |                          | 9             | 8   | 57.8 |
|                   |                      |       | +1131                    | + 5.59   |                  |      | - 2.9                    |               |     |      |
| 9 MO              | -15                  | 0 54  |                          | - 266.93 | -14              | 13.7 |                          | 9             | 12  | 54.4 |
|                   |                      |       | +1147                    | + 5.66   |                  |      | - 2.0                    |               |     |      |
| 10 TU             | -14                  | 41 47 |                          | - 261.27 | -14              | 15.8 |                          | 9             | 16  | 50.9 |
|                   |                      |       | +1161                    | + 5.74   |                  |      | - 1.2                    |               |     |      |
| 11 WE             | -14                  | 22 26 |                          | - 255.53 | -14              | 17.0 |                          | 9             | 20  | 47.5 |
|                   |                      |       | +1176                    | + 5.80   |                  |      | - 0.4                    |               |     |      |
| 12 TH             | -14                  | 2 50  |                          | - 249.73 | -14              | 17.5 |                          | 9             | 24  | 44.1 |
|                   |                      |       | +1190                    | + 5.88   |                  |      | + 0.3                    |               |     |      |
| 13 FR             | -13                  | 43 0  |                          | - 243.85 | -14              | 17.1 |                          | 9             | 28  | 40.6 |
|                   |                      |       | +1203                    | + 5.94   |                  |      | + 1.1                    |               |     |      |
| 14 SA             | -13                  | 22 57 |                          | - 237.91 | -14              | 16.0 |                          | 9             | 32  | 37.2 |
|                   |                      |       | +1216                    | + 6.00   |                  |      | + 1.9                    |               |     |      |
| 15 SU             | -13                  | 2 41  |                          | - 231.91 | -14              | 14.2 |                          | 9             | 36  | 33.7 |
|                   |                      |       | +1229                    | + 6.07   |                  |      | + 2.6                    |               |     |      |
| 16 MO             | -12                  | 42 12 |                          | - 225.84 | -14              | 11.6 |                          | 9             | 40  | 30.3 |
|                   |                      |       | +1241                    | + 6.13   |                  |      | + 3.3                    |               |     |      |
| 17 TU             | -12                  | 21 31 |                          | - 219.71 | -14              | 8.3  |                          | 9             | 44  | 26.8 |
|                   |                      |       | +1253                    | + 6.19   |                  |      | + 4.0                    |               |     |      |
| 18 WE             | -12                  | 0 38  |                          | - 213.52 | -14              | 4.2  |                          | 9             | 48  | 23.4 |
|                   |                      |       | +1264                    | + 6.24   |                  |      | + 4.7                    |               |     |      |
| 19 TH             | -11                  | 39 34 |                          | - 207.28 | -13              | 59.5 |                          | 9             | 52  | 19.9 |
|                   |                      |       | +1276                    | + 6.30   |                  |      | + 5.4                    |               |     |      |
| 20 FR             | -11                  | 18 18 |                          | - 200.98 | -13              | 54.1 |                          | 9             | 56  | 16.5 |
|                   |                      |       | +1286                    | + 6.35   |                  |      | + 6.0                    |               |     |      |
| 21 SA             | -10                  | 56 52 |                          | - 194.63 | -13              | 48.1 |                          | 10            | 0   | 13.0 |
|                   |                      |       | +1297                    | + 6.41   |                  |      | + 6.7                    |               |     |      |
| 22 SU             | -10                  | 35 15 |                          | - 188.22 | -13              | 41.4 |                          | 10            | 4   | 9.6  |
|                   |                      |       | +1307                    | + 6.45   |                  |      | + 7.3                    |               |     |      |
| 23 MO             | -10                  | 13 28 |                          | - 181.77 | -13              | 34.1 |                          | 10            | 8   | 6.1  |
|                   |                      |       | +1316                    | + 6.50   |                  |      | + 7.9                    |               |     |      |
| 24 TU             | - 9                  | 51 32 |                          | - 175.27 | -13              | 26.2 |                          | 10            | 12  | 2.7  |
|                   |                      |       | +1325                    | + 6.54   |                  |      | + 8.5                    |               |     |      |
| 25 WE             | - 9                  | 29 27 |                          | - 168.73 | -13              | 17.7 |                          | 10            | 15  | 59.3 |
|                   |                      |       | +1334                    | + 6.59   |                  |      | + 9.1                    |               |     |      |
| 26 TH             | - 9                  | 7 13  |                          | - 162.14 | -13              | 8.6  |                          | 10            | 19  | 55.8 |
|                   |                      |       | +1342                    | + 6.63   |                  |      | + 9.6                    |               |     |      |
| 27 FR             | - 8                  | 44 51 |                          | - 155.51 | -12              | 58.9 |                          | 10            | 23  | 52.4 |
|                   |                      |       | +1350                    | + 6.67   |                  |      | + 10.2                   |               |     |      |
| 28 SA             | - 8                  | 22 21 |                          | - 148.84 | -12              | 48.7 |                          | 10            | 27  | 48.9 |
|                   |                      |       | +1357                    | + 6.70   |                  |      | + 10.8                   |               |     |      |
| 29 SU             | - 7                  | 59 44 |                          | - 142.14 | -12              | 37.9 |                          | 10            | 31  | 45.5 |
|                   |                      |       | +1365                    | + 6.74   |                  |      | + 11.3                   |               |     |      |



Table 2. Sun, 1976 for Zero Hours Universal Time (GMT) — Continued

| Greenwich<br>date | Apparent declination |                          |          |                           | Equation of time |      |                          | Sidereal time |     |      |
|-------------------|----------------------|--------------------------|----------|---------------------------|------------------|------|--------------------------|---------------|-----|------|
|                   | Degrees              |                          | Mils     |                           | Min              | Sec. | Daily<br>change<br>(sec) | Hr            | Min | Sec  |
|                   |                      | Daily<br>change<br>(sec) | Mils     | Daily<br>change<br>(mils) |                  |      |                          |               |     |      |
| MAR 1 MO          | - 7 36 59            |                          | - 135.40 |                           | -12              | 26.7 |                          | 10            | 35  | 42.0 |
| 2 TU              | - 7 14 9             | +1370                    | - 128.64 | + 6.76                    | -12              | 14.9 | + 11.8                   | 10            | 39  | 38.6 |
| 3 WE              | - 6 51 12            | +1377                    | - 121.84 | + 6.80                    | -12              | 2.6  | + 12.3                   | 10            | 43  | 35.1 |
| 4 TH              | - 6 28 9             | +1383                    | - 115.01 | + 6.83                    | -11              | 49.9 | + 12.8                   | 10            | 47  | 31.7 |
| 5 FR              | - 6 5 1              | +1388                    | - 108.15 | + 6.86                    | -11              | 36.6 | + 13.2                   | 10            | 51  | 28.2 |
| 6 SA              | - 5 41 48            | +1393                    | - 101.27 | + 6.88                    | -11              | 23.0 | + 13.7                   | 10            | 55  | 24.8 |
| 7 SU              | - 5 18 30            | +1398                    | - 94.27  | + 6.90                    | -11              | 8.9  | + 14.1                   | 10            | 59  | 21.3 |
| 8 MO              | - 4 55 9             | +1401                    | - 87.45  | + 6.92                    | -10              | 54.4 | + 14.5                   | 11            | 3   | 17.9 |
| 9 TU              | - 4 31 43            | +1406                    | - 80.51  | + 6.94                    | -10              | 39.5 | + 14.9                   | 11            | 7   | 14.4 |
| 10 WE             | - 4 8 14             | +1409                    | - 73.55  | + 6.96                    | -10              | 24.2 | + 15.3                   | 11            | 11  | 11.0 |
| 11 TH             | - 3 44 43            | +1411                    | - 66.58  | + 6.97                    | -10              | 8.6  | + 15.6                   | 11            | 15  | 7.5  |
| 12 FR             | - 3 21 8             | +1415                    | - 59.60  | + 6.98                    | - 9              | 52.6 | + 16.0                   | 11            | 19  | 4.1  |
| 13 SA             | - 2 57 32            | +1416                    | - 52.60  | + 7.00                    | - 9              | 36.4 | + 16.3                   | 11            | 23  | 0.7  |
| 14 SU             | - 2 33 53            | +1419                    | - 45.59  | + 7.01                    | - 9              | 19.8 | + 16.6                   | 11            | 26  | 57.2 |
| 15 MO             | - 2 10 13            | +1420                    | - 38.58  | + 7.01                    | - 9              | 3.0  | + 16.8                   | 11            | 30  | 53.8 |
| 16 TU             | - 1 46 32            | +1421                    | - 31.56  | + 7.02                    | - 8              | 45.9 | + 17.1                   | 11            | 34  | 50.3 |
| 17 WE             | - 1 22 49            | +1423                    | - 24.54  | + 7.02                    | - 8              | 28.6 | + 17.3                   | 11            | 38  | 46.8 |
| 18 TH             | - 0 59 7             | +1422                    | - 17.51  | + 7.03                    | - 8              | 11.2 | + 17.5                   | 11            | 42  | 43.4 |
| 19 FR             | - 0 35 24            | +1423                    | - 10.49  | + 7.02                    | - 7              | 53.5 | + 17.6                   | 11            | 46  | 39.9 |
| 20 SA             | - 0 11 41            | +1423                    | - 3.46   | + 7.03                    | - 7              | 35.7 | + 17.8                   | 11            | 50  | 36.5 |
| 21 SU             | + 0 12 1             | +1422                    | + 3.56   | + 7.02                    | - 7              | 17.8 | + 17.9                   | 11            | 54  | 33.1 |
| 22 MO             | + 0 35 42            | +1421                    | + 10.58  | + 7.02                    | - 6              | 59.8 | + 18.0                   | 11            | 58  | 29.6 |
| 23 TU             | + 0 59 23            | +1421                    | + 17.59  | + 7.01                    | - 6              | 41.8 | + 18.1                   | 12            | 2   | 26.2 |
| 24 WE             | + 1 23 1             | +1418                    | + 24.60  | + 7.01                    | - 6              | 23.7 | + 18.1                   | 12            | 6   | 22.7 |
| 25 TH             | + 1 46 38            | +1417                    | + 31.59  | + 6.99                    | - 6              | 5.5  | + 18.1                   | 12            | 10  | 19.3 |
| 26 FR             | + 2 10 12            | +1414                    | + 38.58  | + 6.99                    | - 5              | 47.3 | + 18.2                   | 12            | 14  | 15.8 |
| 27 SA             | + 2 33 43            | +1411                    | + 45.55  | + 6.97                    | - 5              | 29.2 | + 18.2                   | 12            | 18  | 12.4 |
| 28 SU             | + 2 57 11            | +1408                    | + 52.50  | + 6.95                    | - 5              | 11.0 | + 18.1                   | 12            | 22  | 8.9  |
| 29 MO             | + 3 20 36            | +1405                    | + 59.44  | + 6.94                    | - 4              | 52.9 | + 18.1                   | 12            | 26  | 5.5  |
| 30 TU             | + 3 43 57            | +1401                    | + 66.36  | + 6.92                    | - 4              | 34.9 | + 18.1                   | 12            | 30  | 2.0  |
| 31 WE             | + 4 7 14             | +1397                    | + 73.25  | + 6.89                    | - 4              | 16.9 | + 18.0                   | 12            | 33  | 58.6 |
|                   |                      | +1392                    |          | + 6.88                    |                  |      | + 17.9                   |               |     |      |

Table 2. Sun, 1976 for Zero Hours Universal Time (GMT) — Continued

| Greenwich<br>date | Apparent declination |       |          |                           | Equation of time |      |                          | Sidereal time |     |      |
|-------------------|----------------------|-------|----------|---------------------------|------------------|------|--------------------------|---------------|-----|------|
|                   | Degrees              |       | Mils     |                           | Min              | Sec  | Daily<br>change<br>(sec) | Hr            | Min | Sec  |
|                   | °                    | ' "   | Mils     | Daily<br>change<br>(mils) |                  |      |                          |               |     |      |
| APR 1 TH          | + 4                  | 30 26 | + 80.13  |                           | - 3              | 59.0 |                          | 12            | 37  | 55.1 |
| 2 FR              | + 4                  | 53 34 | + 86.98  | + 6.85                    | - 3              | 41.2 | + 17.8                   | 12            | 41  | 51.7 |
| 3 SA              | + 5                  | 16 36 | + 93.81  | + 6.83                    | - 3              | 23.5 | + 17.7                   | 12            | 45  | 48.2 |
| 4 SU              | + 5                  | 39 32 | + 100.60 | + 6.79                    | - 3              | 6.0  | + 17.5                   | 12            | 49  | 44.8 |
| 5 MO              | + 6                  | 2 23  | + 107.37 | + 6.77                    | - 2              | 48.6 | + 17.4                   | 12            | 53  | 41.3 |
| 6 TU              | + 6                  | 25 7  | + 114.11 | + 6.74                    | - 2              | 31.3 | + 17.2                   | 12            | 57  | 37.9 |
| 7 WE              | + 6                  | 47 44 | + 120.81 | + 6.70                    | - 2              | 14.3 | + 17.0                   | 13            | 1   | 34.4 |
| 8 TH              | + 7                  | 10 15 | + 127.48 | + 6.67                    | - 1              | 57.5 | + 16.8                   | 13            | 5   | 31.0 |
| 9 FR              | + 7                  | 32 38 | + 134.11 | + 6.63                    | - 1              | 40.8 | + 16.6                   | 13            | 9   | 27.6 |
| 10 SA             | + 7                  | 54 53 | + 140.71 | + 6.60                    | - 1              | 24.5 | + 16.4                   | 13            | 13  | 24.1 |
| 11 SU             | + 8                  | 17 0  | + 147.26 | + 6.55                    | - 1              | 8.3  | + 16.1                   | 13            | 17  | 20.7 |
| 12 MO             | + 8                  | 38 59 | + 153.77 | + 6.51                    | - 0              | 52.4 | + 15.9                   | 13            | 21  | 17.2 |
| 13 TU             | + 9                  | 0 49  | + 160.24 | + 6.47                    | - 0              | 36.9 | + 15.6                   | 13            | 25  | 13.8 |
| 14 WE             | + 9                  | 22 30 | + 166.67 | + 6.43                    | - 0              | 21.6 | + 15.3                   | 13            | 29  | 10.3 |
| 15 TH             | + 9                  | 44 2  | + 173.05 | + 6.38                    | - 0              | 6.7  | + 14.9                   | 13            | 33  | 6.9  |
| 16 FR             | +10                  | 5 24  | + 179.38 | + 6.33                    | + 0              | 7.9  | + 14.6                   | 13            | 37  | 3.4  |
| 17 SA             | +10                  | 26 37 | + 185.66 | + 6.28                    | + 0              | 22.1 | + 14.2                   | 13            | 41  | 0.0  |
| 18 SU             | +10                  | 47 38 | + 191.89 | + 6.23                    | + 0              | 35.9 | + 13.8                   | 13            | 44  | 56.5 |
| 19 MO             | +11                  | 8 30  | + 198.07 | + 6.18                    | + 0              | 49.3 | + 13.4                   | 13            | 48  | 53.1 |
| 20 TU             | +11                  | 29 10 | + 204.20 | + 6.13                    | + 1              | 2.3  | + 13.0                   | 13            | 52  | 49.6 |
| 21 WE             | +11                  | 49 40 | + 210.27 | + 6.07                    | + 1              | 14.8 | + 12.5                   | 13            | 56  | 46.2 |
| 22 TH             | +12                  | 9 57  | + 216.28 | + 6.01                    | + 1              | 26.9 | + 12.1                   | 14            | 0   | 42.8 |
| 23 FR             | +12                  | 30 3  | + 222.24 | + 5.96                    | + 1              | 38.5 | + 11.6                   | 14            | 4   | 39.3 |
| 24 SA             | +12                  | 49 56 | + 228.13 | + 5.89                    | + 1              | 49.7 | + 11.1                   | 14            | 8   | 35.9 |
| 25 SU             | +13                  | 9 37  | + 233.96 | + 5.83                    | + 2              | 0.3  | + 10.6                   | 14            | 12  | 32.4 |
| 26 MO             | +13                  | 29 5  | + 239.73 | + 5.77                    | + 2              | 10.5 | + 10.2                   | 14            | 16  | 29.0 |
| 27 TU             | +13                  | 48 19 | + 245.43 | + 5.70                    | + 2              | 20.1 | + 9.6                    | 14            | 20  | 25.5 |
| 28 WE             | +14                  | 7 20  | + 251.06 | + 5.63                    | + 2              | 29.3 | + 9.1                    | 14            | 24  | 22.1 |
| 29 TH             | +14                  | 26 7  | + 256.63 | + 5.57                    | + 2              | 37.9 | + 8.6                    | 14            | 28  | 18.6 |
| 30 FR             | +14                  | 44 40 | + 262.12 | + 5.49                    | + 2              | 46.0 | + 8.1                    | 14            | 32  | 15.2 |
|                   |                      | +1097 |          | + 5.42                    |                  |      | + 7.6                    |               |     |      |

**Table 2. Sun, 1976 for Zero Hours Universal Time (GMT) — Continued**

| Greenwich<br>date | Apparent declination |       |                          |                           | Equation of time |      |                          | Sidereal time |     |      |
|-------------------|----------------------|-------|--------------------------|---------------------------|------------------|------|--------------------------|---------------|-----|------|
|                   | Degrees              |       | Mils                     |                           | Min              | Sec  | Daily<br>change<br>(sec) | Hr            | Min | Sec  |
|                   | °                    | ' "   | Daily<br>change<br>(sec) | Daily<br>change<br>(mils) |                  |      |                          |               |     |      |
| MAY 1 SA          | +15                  | 2 57  |                          | + 267.54                  | + 2              | 53.6 |                          | 14            | 36  | 11.7 |
| 2 SU              | +15                  | 21 1  | +1084                    | + 272.89                  | + 3              | 0.6  | + 7.0                    | 14            | 40  | 8.3  |
| 3 MO              | +15                  | 38 48 | +1067                    | + 278.17                  | + 3              | 7.1  | + 6.5                    | 14            | 44  | 4.8  |
| 4 TU              | +15                  | 56 21 | +1053                    | + 283.36                  | + 3              | 13.1 | + 6.0                    | 14            | 48  | 1.4  |
| 5 WE              | +16                  | 13 37 | +1036                    | + 288.48                  | + 3              | 18.5 | + 5.4                    | 14            | 51  | 57.9 |
| 6 TH              | +16                  | 30 37 | +1020                    | + 293.52                  | + 3              | 23.4 | + 4.9                    | 14            | 55  | 54.5 |
| 7 FR              | +16                  | 47 21 | +1004                    | + 298.47                  | + 3              | 27.8 | + 4.3                    | 14            | 59  | 51.1 |
| 8 SA              | +17                  | 3 48  | + 987                    | + 303.35                  | + 3              | 31.5 | + 3.8                    | 15            | 3   | 47.6 |
| 9 SU              | +17                  | 19 57 | + 969                    | + 308.14                  | + 3              | 34.8 | + 3.3                    | 15            | 7   | 44.2 |
| 10 MO             | +17                  | 35 50 | + 953                    | + 312.84                  | + 3              | 37.5 | + 2.7                    | 15            | 11  | 40.7 |
| 11 TU             | +17                  | 51 24 | + 934                    | + 317.45                  | + 3              | 39.6 | + 2.1                    | 15            | 15  | 37.3 |
| 12 WF             | +18                  | 6 41  | + 917                    | + 321.98                  | + 3              | 41.2 | + 1.6                    | 15            | 19  | 33.8 |
| 13 TH             | +18                  | 21 39 | + 898                    | + 326.41                  | + 3              | 42.3 | + 1.0                    | 15            | 23  | 30.4 |
| 14 FR             | +18                  | 36 19 | + 880                    | + 330.76                  | + 3              | 42.7 | + 0.4                    | 15            | 27  | 26.9 |
| 15 SA             | +18                  | 50 39 | + 860                    | + 335.01                  | + 3              | 42.6 | - 0.1                    | 15            | 31  | 23.5 |
| 16 SU             | +19                  | 4 41  | + 842                    | + 339.17                  | + 3              | 41.9 | - 0.7                    | 15            | 35  | 20.0 |
| 17 MO             | +19                  | 18 24 | + 823                    | + 343.23                  | + 3              | 40.6 | - 1.3                    | 15            | 39  | 16.6 |
| 18 TU             | +19                  | 31 47 | + 803                    | + 347.19                  | + 3              | 38.8 | - 1.8                    | 15            | 43  | 13.2 |
| 19 WE             | +19                  | 44 50 | + 783                    | + 351.06                  | + 3              | 36.4 | - 2.4                    | 15            | 47  | 9.7  |
| 20 TH             | +19                  | 57 33 | + 763                    | + 354.83                  | + 3              | 33.4 | - 3.0                    | 15            | 51  | 6.3  |
| 21 FR             | +20                  | 9 55  | + 742                    | + 358.49                  | + 3              | 29.9 | - 3.5                    | 15            | 55  | 2.8  |
| 22 SA             | +20                  | 21 57 | + 722                    | + 362.06                  | + 3              | 25.8 | - 4.1                    | 15            | 58  | 59.4 |
| 23 SU             | +20                  | 33 38 | + 701                    | + 365.52                  | + 3              | 21.2 | - 4.6                    | 16            | 2   | 55.9 |
| 24 MO             | +20                  | 44 58 | + 680                    | + 368.88                  | + 3              | 16.0 | - 5.2                    | 16            | 6   | 52.5 |
| 25 TU             | +20                  | 55 56 | + 658                    | + 372.13                  | + 3              | 10.3 | - 5.7                    | 16            | 10  | 49.0 |
| 26 WE             | +21                  | 6 33  | + 637                    | + 375.27                  | + 3              | 4.1  | - 6.2                    | 16            | 14  | 45.6 |
| 27 TH             | +21                  | 16 48 | + 615                    | + 378.31                  | + 2              | 57.4 | - 6.7                    | 16            | 18  | 42.1 |
| 28 FR             | +21                  | 26 41 | + 593                    | + 381.24                  | + 2              | 50.2 | - 7.2                    | 16            | 22  | 38.7 |
| 29 SA             | +21                  | 36 11 | + 570                    | + 384.06                  | + 2              | 42.6 | - 7.6                    | 16            | 26  | 35.3 |
| 30 SU             | +21                  | 45 20 | + 549                    | + 386.76                  | + 2              | 34.5 | - 8.1                    | 16            | 30  | 31.8 |
| 31 MO             | +21                  | 54 5  | + 525                    | + 389.26                  | + 2              | 26.0 | - 8.5                    | 16            | 34  | 28.4 |
|                   |                      |       | + 503                    | + 2.48                    |                  |      | - 8.9                    |               |     |      |

Table 2. Sun, 1976 for Zero Hours Universal Time (GMT) — Continued

| Greenwich<br>date | Apparent declination |       |                          |          | Equation of time          |     |      | Sidereal time            |    |         |
|-------------------|----------------------|-------|--------------------------|----------|---------------------------|-----|------|--------------------------|----|---------|
|                   | Degrees              |       | Daily<br>change<br>(sec) | Mils     |                           | Min | Sec  | Daily<br>change<br>(sec) | Hr | Min Sec |
|                   | °                    | ' "   |                          | Mils     | Daily<br>change<br>(mils) |     |      |                          |    |         |
| JUN 1 TU          | +22                  | 2 28  |                          | + 391.84 |                           | + 2 | 17.1 |                          | 16 | 38 24.9 |
| 2 WE              | +22                  | 10 28 | + 480                    | + 394.21 | + 2.37                    | + 2 | 7.8  | - 9.3                    | 16 | 42 21.5 |
| 3 TH              | +22                  | 18 4  | + 456                    | + 396.46 | + 2.25                    | + 1 | 58.1 | - 9.7                    | 16 | 46 18.1 |
| 4 FR              | +22                  | 25 17 | + 433                    | + 398.60 | + 2.14                    | + 1 | 48.1 | - 10.0                   | 16 | 50 14.6 |
| 5 SA              | +22                  | 32 6  | + 409                    | + 400.62 | + 2.02                    | + 1 | 37.7 | - 10.3                   | 16 | 54 11.2 |
| 6 SU              | +22                  | 38 32 | + 386                    | + 402.53 | + 1.91                    | + 1 | 27.1 | - 10.7                   | 16 | 58 7.7  |
| 7 MO              | +22                  | 44 34 | + 362                    | + 404.32 | + 1.79                    | + 1 | 16.1 | - 10.9                   | 17 | 2 4.3   |
| 8 TU              | +22                  | 50 12 | + 338                    | + 405.99 | + 1.67                    | + 1 | 4.9  | - 11.2                   | 17 | 6 0.8   |
| 9 WE              | +22                  | 55 26 | + 314                    | + 407.54 | + 1.55                    | + 0 | 53.4 | - 11.5                   | 17 | 9 57.4  |
| 10 TH             | +23                  | 0 16  | + 290                    | + 408.97 | + 1.43                    | + 0 | 41.7 | - 11.7                   | 17 | 13 53.9 |
| 11 FR             | +23                  | 4 41  | + 265                    | + 410.28 | + 1.31                    | + 0 | 29.8 | - 11.9                   | 17 | 17 50.5 |
| 12 SA             | +23                  | 8 42  | + 241                    | + 411.47 | + 1.19                    | + 0 | 17.7 | - 12.1                   | 17 | 21 47.1 |
| 13 SU             | +23                  | 12 19 | + 217                    | + 412.54 | + 1.07                    | + 0 | 5.4  | - 12.3                   | 17 | 25 43.6 |
| 14 MO             | +23                  | 15 31 | + 192                    | + 413.49 | + 0.95                    | - 0 | 7.0  | - 12.5                   | 17 | 29 40.2 |
| 15 TU             | +23                  | 18 19 | + 168                    | + 414.31 | + 0.82                    | - 0 | 19.7 | - 12.6                   | 17 | 33 36.8 |
| 16 WE             | +23                  | 20 41 | + 142                    | + 415.02 | + 0.71                    | - 0 | 32.4 | - 12.7                   | 17 | 37 33.3 |
| 17 TH             | +23                  | 22 40 | + 119                    | + 415.60 | + 0.58                    | - 0 | 45.3 | - 12.9                   | 17 | 41 29.9 |
| 18 FR             | +23                  | 24 13 | + 93                     | + 416.06 | + 0.46                    | - 0 | 58.2 | - 12.9                   | 17 | 45 26.4 |
| 19 SA             | +23                  | 25 21 | + 68                     | + 416.40 | + 0.34                    | - 1 | 11.2 | - 13.0                   | 17 | 49 23.0 |
| 20 SU             | +23                  | 26 5  | + 44                     | + 416.62 | + 0.22                    | - 1 | 24.3 | - 13.0                   | 17 | 53 19.5 |
| 21 MO             | +23                  | 26 24 | + 19                     | + 416.71 | + 0.09                    | - 1 | 37.3 | - 13.1                   | 17 | 57 16.1 |
| 22 TU             | +23                  | 26 18 | - 6                      | + 416.68 | - 0.03                    | - 1 | 50.4 | - 13.0                   | 18 | 1 12.6  |
| 23 WE             | +23                  | 25 47 | - 31                     | + 416.53 | - 0.15                    | - 2 | 3.4  | - 13.0                   | 18 | 5 9.2   |
| 24 TH             | +23                  | 24 52 | - 55                     | + 416.26 | - 0.27                    | - 2 | 16.4 | - 13.0                   | 18 | 9 5.7   |
| 25 FR             | +23                  | 23 32 | - 80                     | + 415.86 | - 0.40                    | - 2 | 29.3 | - 12.9                   | 18 | 13 2.3  |
| 26 SA             | +23                  | 21 47 | - 105                    | + 415.34 | - 0.52                    | - 2 | 42.0 | - 12.8                   | 18 | 16 58.9 |
| 27 SU             | +23                  | 19 37 | - 130                    | + 414.70 | - 0.64                    | - 2 | 54.7 | - 12.6                   | 18 | 20 55.4 |
| 28 MO             | +23                  | 17 3  | - 154                    | + 413.94 | - 0.76                    | - 3 | 7.2  | - 12.5                   | 18 | 24 52.0 |
| 29 TU             | +23                  | 14 4  | - 179                    | + 413.06 | - 0.88                    | - 3 | 19.4 | - 12.3                   | 18 | 28 48.5 |
| 30 WE             | +23                  | 10 41 | - 203                    | + 412.05 | - 1.01                    | - 3 | 31.5 | - 12.1                   | 18 | 32 45.1 |
|                   |                      |       | - 227                    |          | - 1.12                    |     |      | - 11.8                   |    |         |

Table 2. Sun, 1976 for Zero Hours Universal Time (GMT) — Continued

| Greenwich<br>date | Apparent declination |    |    |                          |                           | Equation of time |      |                          | Sidereal time |     |      |
|-------------------|----------------------|----|----|--------------------------|---------------------------|------------------|------|--------------------------|---------------|-----|------|
|                   | Degrees              |    |    | Mils                     |                           | Min              | Sec  | Daily<br>change<br>(sec) | Hr            | Min | Sec  |
|                   | °                    | '  | "  | Daily<br>change<br>(sec) | Daily<br>change<br>(mils) |                  |      |                          |               |     |      |
| JUL 1 TH          | +23                  | 6  | 54 |                          | + 410.93                  | - 3              | 43.3 |                          | 18            | 36  | 41.7 |
| 2 FR              | +23                  | 2  | 42 | - 252                    | - 1.24                    | - 3              | 54.9 | - 11.6                   | 18            | 40  | 38.2 |
| 3 SA              | +22                  | 58 | 6  | - 276                    | - 1.36                    | - 4              | 6.2  | - 11.2                   | 18            | 44  | 34.8 |
| 4 SU              | +22                  | 53 | 7  | - 299                    | - 1.48                    | - 4              | 17.1 | - 10.9                   | 18            | 48  | 31.3 |
| 5 MO              | +22                  | 47 | 43 | - 324                    | - 1.60                    | - 4              | 27.8 | - 10.6                   | 18            | 52  | 27.9 |
| 6 TU              | +22                  | 41 | 56 | - 347                    | - 1.72                    | - 4              | 38.0 | - 10.3                   | 18            | 56  | 24.4 |
| 7 WE              | +22                  | 35 | 45 | - 371                    | - 1.83                    | - 4              | 47.9 | - 9.9                    | 19            | 0   | 21.0 |
| 8 TH              | +22                  | 29 | 10 | - 395                    | - 1.95                    | - 4              | 57.4 | - 9.5                    | 19            | 4   | 17.5 |
| 9 FR              | +22                  | 22 | 13 | - 417                    | - 2.06                    | - 5              | 6.4  | - 9.1                    | 19            | 8   | 14.1 |
| 10 SA             | +22                  | 14 | 52 | - 441                    | - 2.18                    | - 5              | 15.1 | - 8.7                    | 19            | 12  | 10.7 |
| 11 SU             | +22                  | 7  | 8  | - 464                    | - 2.29                    | - 5              | 23.3 | - 8.2                    | 19            | 16  | 7.2  |
| 12 MO             | +21                  | 59 | 1  | - 487                    | - 2.40                    | - 5              | 31.1 | - 7.8                    | 19            | 20  | 3.8  |
| 13 TU             | +21                  | 50 | 32 | - 509                    | - 2.51                    | - 5              | 38.4 | - 7.3                    | 19            | 24  | 0.3  |
| 14 WE             | +21                  | 41 | 40 | - 532                    | - 2.63                    | - 5              | 45.3 | - 6.8                    | 19            | 27  | 56.9 |
| 15 TH             | +21                  | 32 | 27 | - 553                    | - 2.73                    | - 5              | 51.6 | - 6.4                    | 19            | 31  | 53.5 |
| 16 FR             | +21                  | 22 | 51 | - 576                    | - 2.85                    | - 5              | 57.5 | - 5.9                    | 19            | 35  | 50.0 |
| 17 SA             | +21                  | 12 | 53 | - 598                    | - 2.95                    | - 6              | 2.9  | - 5.4                    | 19            | 39  | 46.6 |
| 18 SU             | +21                  | 2  | 33 | - 620                    | - 3.06                    | - 6              | 7.8  | - 4.9                    | 19            | 43  | 43.1 |
| 19 MO             | +20                  | 51 | 53 | - 640                    | - 3.16                    | - 6              | 12.1 | - 4.4                    | 19            | 47  | 39.7 |
| 20 TU             | +20                  | 40 | 51 | - 662                    | - 3.27                    | - 6              | 15.9 | - 3.8                    | 19            | 51  | 36.2 |
| 21 WE             | +20                  | 29 | 28 | - 683                    | - 3.38                    | - 6              | 19.2 | - 3.3                    | 19            | 55  | 32.8 |
| 22 TH             | +20                  | 17 | 44 | - 704                    | - 3.47                    | - 6              | 22.0 | - 2.7                    | 19            | 59  | 29.3 |
| 23 FR             | +20                  | 5  | 40 | - 724                    | - 3.58                    | - 6              | 24.2 | - 2.2                    | 20            | 3   | 25.9 |
| 24 SA             | +19                  | 53 | 16 | - 744                    | - 3.67                    | - 6              | 25.8 | - 1.6                    | 20            | 7   | 22.4 |
| 25 SU             | +19                  | 40 | 32 | - 764                    | - 3.77                    | - 6              | 26.8 | - 1.0                    | 20            | 11  | 19.0 |
| 26 MO             | +19                  | 27 | 28 | - 784                    | - 3.87                    | - 6              | 27.3 | - 0.5                    | 20            | 15  | 15.6 |
| 27 TU             | +19                  | 14 | 5  | - 803                    | - 3.97                    | - 6              | 27.2 | + 0.1                    | 20            | 19  | 12.1 |
| 28 WE             | +19                  | 0  | 23 | - 822                    | - 4.06                    | - 6              | 26.4 | + 0.7                    | 20            | 23  | 8.7  |
| 29 TH             | +18                  | 46 | 22 | - 841                    | - 4.15                    | - 6              | 25.1 | + 1.3                    | 20            | 27  | 5.2  |
| 30 FR             | +18                  | 32 | 3  | - 859                    | - 4.25                    | - 6              | 23.2 | + 1.9                    | 20            | 31  | 1.8  |
| 31 SA             | +18                  | 17 | 25 | - 878                    | - 4.33                    | - 6              | 20.6 | + 2.6                    | 20            | 34  | 58.3 |
|                   |                      |    |    | - 895                    | - 4.42                    |                  |      | + 3.2                    |               |     |      |

**Table 2. Sun, 1976 for Zero Hours Universal Time (GMT) — Continued**

| Greenwich<br>date | Apparent declination |    |    |                          |                           | Equation of time |      |                          | Sidereal time |     |      |
|-------------------|----------------------|----|----|--------------------------|---------------------------|------------------|------|--------------------------|---------------|-----|------|
|                   | Degrees              |    |    | Mils                     |                           | Min              | Sec  | Daily<br>change<br>(sec) | Hr            | Min | Sec  |
|                   | °                    | '  | "  | Daily<br>change<br>(sec) | Daily<br>change<br>(mils) |                  |      |                          |               |     |      |
| AUG 1 SU          | +18                  | 2  | 30 | - 914                    | + 320.74 - 4.51           | - 6              | 17.4 | + 3.8                    | 20            | 38  | 54.9 |
| 2 MO              | +17                  | 47 | 16 | - 930                    | + 316.23 - 4.59           | - 6              | 13.6 | + 4.4                    | 20            | 42  | 51.4 |
| 3 TU              | +17                  | 31 | 46 | - 947                    | + 311.64 - 4.68           | - 6              | 9.1  | + 5.1                    | 20            | 46  | 48.0 |
| 4 WE              | +17                  | 15 | 59 | - 964                    | + 306.96 - 4.76           | - 6              | 4.1  | + 5.7                    | 20            | 50  | 44.5 |
| 5 TH              | +16                  | 59 | 55 | - 981                    | + 302.20 - 4.85           | - 5              | 58.4 | + 6.3                    | 20            | 54  | 41.1 |
| 6 FR              | +16                  | 43 | 34 | - 996                    | + 297.35 - 4.92           | - 5              | 52.1 | + 6.9                    | 20            | 58  | 37.7 |
| 7 SA              | +16                  | 26 | 58 | -1013                    | + 292.43 - 5.00           | - 5              | 45.1 | + 7.5                    | 21            | 2   | 34.2 |
| 8 SU              | +16                  | 10 | 5  | -1028                    | + 287.43 - 5.07           | - 5              | 37.6 | + 8.1                    | 21            | 6   | 30.8 |
| 9 MO              | +15                  | 52 | 57 | -1043                    | + 282.36 - 5.16           | - 5              | 29.5 | + 8.7                    | 21            | 10  | 27.3 |
| 10 TU             | +15                  | 35 | 34 | -1058                    | + 277.20 - 5.22           | - 5              | 20.8 | + 9.3                    | 21            | 14  | 23.9 |
| 11 WE             | +15                  | 17 | 56 | -1073                    | + 271.98 - 5.30           | - 5              | 11.5 | + 9.8                    | 21            | 18  | 20.4 |
| 12 TH             | +15                  | 0  | 3  | -1088                    | + 266.68 - 5.37           | - 5              | 1.7  | + 10.4                   | 21            | 22  | 17.0 |
| 13 FR             | +14                  | 41 | 55 | -1101                    | + 261.31 - 5.44           | - 4              | 51.3 | + 10.9                   | 21            | 26  | 13.5 |
| 14 SA             | +14                  | 23 | 34 | -1116                    | + 255.87 - 5.51           | - 4              | 40.4 | + 11.5                   | 21            | 30  | 10.1 |
| 15 SU             | +14                  | 4  | 58 | -1128                    | + 250.36 - 5.57           | - 4              | 28.9 | + 12.0                   | 21            | 34  | 6.6  |
| 16 MO             | +13                  | 46 | 10 | -1142                    | + 244.79 - 5.64           | - 4              | 16.9 | + 12.5                   | 21            | 38  | 3.2  |
| 17 TU             | +13                  | 27 | 8  | -1155                    | + 239.15 - 5.70           | - 4              | 4.5  | + 13.0                   | 21            | 41  | 59.7 |
| 18 WE             | +13                  | 7  | 53 | -1168                    | + 233.45 - 5.77           | - 3              | 51.5 | + 13.5                   | 21            | 45  | 56.3 |
| 19 TH             | +12                  | 48 | 25 | -1180                    | + 227.68 - 5.83           | - 3              | 38.0 | + 13.9                   | 21            | 49  | 52.9 |
| 20 FR             | +12                  | 28 | 45 | -1191                    | + 221.85 - 5.88           | - 3              | 24.1 | + 14.4                   | 21            | 53  | 49.4 |
| 21 SA             | +12                  | 8  | 54 | -1203                    | + 215.97 - 5.94           | - 3              | 9.7  | + 14.8                   | 21            | 57  | 46.0 |
| 22 SU             | +11                  | 48 | 51 | -1215                    | + 210.03 - 6.00           | - 2              | 54.9 | + 15.3                   | 22            | 1   | 42.5 |
| 23 MO             | +11                  | 28 | 36 | -1225                    | + 204.03 - 6.05           | - 2              | 39.6 | + 15.7                   | 22            | 5   | 39.1 |
| 24 TU             | +11                  | 8  | 11 | -1236                    | + 197.98 - 6.11           | - 2              | 23.9 | + 16.1                   | 22            | 9   | 35.6 |
| 25 WE             | +10                  | 47 | 35 | -1247                    | + 191.87 - 6.15           | - 2              | 7.8  | + 16.5                   | 22            | 13  | 32.2 |
| 26 TH             | +10                  | 26 | 48 | -1256                    | + 185.72 - 6.20           | - 1              | 51.2 | + 16.9                   | 22            | 17  | 28.7 |
| 27 FR             | +10                  | 5  | 52 | -1265                    | + 179.52 - 6.25           | - 1              | 34.3 | + 17.3                   | 22            | 21  | 25.3 |
| 28 SA             | + 9                  | 44 | 47 | -1276                    | + 173.27 - 6.30           | - 1              | 17.0 | + 17.7                   | 22            | 25  | 21.8 |
| 29 SU             | + 9                  | 23 | 31 | -1283                    | + 166.97 - 6.34           | - 0              | 59.3 | + 18.0                   | 22            | 29  | 18.4 |
| 30 MO             | + 9                  | 2  | 8  | -1293                    | + 160.63 - 6.38           | - 0              | 41.2 | + 18.4                   | 22            | 33  | 14.9 |
| 31 TU             | + 8                  | 40 | 35 | -1301                    | + 154.25 - 6.43           | - 0              | 22.8 | + 18.8                   | 22            | 37  | 11.5 |

**Table 2. Sun, 1976 for Zero Hours Universal Time (GMT) — Continued**

| Greenwich<br>date | Apparent declination |       |                          |          | Equation of time          |     |      | Sidereal time            |    |     |      |
|-------------------|----------------------|-------|--------------------------|----------|---------------------------|-----|------|--------------------------|----|-----|------|
|                   | Degrees              |       | Daily<br>change<br>(sec) | Mils     |                           | Min | Sec  | Daily<br>change<br>(sec) | Hr | Min | Sec  |
|                   | °                    | ' "   |                          | Mils     | Daily<br>change<br>(mils) |     |      |                          |    |     |      |
| SEP 1 WE          | + 8                  | 18 54 |                          | + 147.82 |                           | - 0 | 4.1  |                          | 22 | 41  | 8.1  |
| 2 TH              | + 7                  | 57 6  | -1308                    | + 141.36 | - 6.46                    | + 0 | 15.0 | + 19.1                   | 22 | 45  | 4.6  |
| 3 FR              | + 7                  | 35 10 | -1316                    | + 134.86 | - 6.50                    | + 0 | 34.3 | + 19.4                   | 22 | 49  | 1.2  |
| 4 SA              | + 7                  | 13 6  | -1324                    | + 128.33 | - 6.53                    | + 0 | 54.0 | + 19.6                   | 22 | 52  | 57.7 |
| 5 SU              | + 6                  | 50 56 | -1330                    | + 121.76 | - 6.57                    | + 1 | 13.9 | + 19.9                   | 22 | 56  | 54.3 |
| 6 MO              | + 6                  | 28 39 | -1337                    | + 115.15 | - 6.61                    | + 1 | 34.0 | + 20.1                   | 22 | 56  | 54.3 |
| 7 TU              | + 6                  | 6 15  | -1344                    | + 108.52 | - 6.63                    | + 1 | 54.4 | + 20.4                   | 23 | 0   | 50.8 |
| 8 WE              | + 5                  | 43 46 | -1349                    | + 101.86 | - 6.66                    | + 1 | 54.4 | + 20.6                   | 23 | 4   | 47.4 |
| 9 TH              | + 5                  | 21 11 | -1355                    | + 95.16  | - 6.70                    | + 2 | 15.0 | + 20.8                   | 23 | 8   | 43.9 |
| 10 FR             | + 4                  | 58 30 | -1361                    | + 88.44  | - 6.72                    | + 2 | 35.7 | + 20.9                   | 23 | 12  | 40.5 |
| 11 SA             | + 4                  | 35 44 | -1366                    | + 81.70  | - 6.74                    | + 2 | 56.6 | + 21.0                   | 23 | 16  | 37.0 |
| 12 SU             | + 4                  | 12 53 | -1371                    | + 74.93  | - 6.77                    | + 3 | 17.6 | + 21.1                   | 23 | 20  | 33.6 |
| 13 MO             | + 3                  | 49 58 | -1375                    | + 68.14  | - 6.79                    | + 3 | 38.8 | + 21.2                   | 23 | 24  | 30.1 |
| 14 TU             | + 3                  | 26 59 | -1379                    | + 61.33  | - 6.81                    | + 4 | 0.0  | + 21.3                   | 23 | 28  | 26.7 |
| 15 WE             | + 3                  | 3 56  | -1383                    | + 54.50  | - 6.83                    | + 4 | 21.3 | + 21.3                   | 23 | 32  | 23.2 |
| 16 TH             | + 2                  | 40 49 | -1387                    | + 47.65  | - 6.85                    | + 4 | 42.6 | + 21.3                   | 23 | 36  | 19.8 |
| 17 FR             | + 2                  | 17 39 | -1390                    | + 40.79  | - 6.86                    | + 5 | 4.0  | + 21.4                   | 23 | 40  | 16.3 |
| 18 SA             | + 1                  | 54 26 | -1393                    | + 33.91  | - 6.88                    | + 5 | 25.4 | + 21.3                   | 23 | 44  | 12.9 |
| 19 SU             | + 1                  | 31 11 | -1395                    | + 27.02  | - 6.89                    | + 5 | 46.7 | + 21.3                   | 23 | 48  | 9.4  |
| 20 MO             | + 1                  | 7 54  | -1397                    | + 20.12  | - 6.90                    | + 6 | 8.0  | + 21.3                   | 23 | 52  | 6.0  |
| 21 TU             | + 0                  | 44 34 | -1400                    | + 13.21  | - 6.91                    | + 6 | 29.3 | + 21.2                   | 23 | 56  | 2.6  |
| 22 WE             | + 0                  | 21 14 | -1400                    | + 6.29   | - 6.91                    | + 6 | 29.3 | + 21.2                   | 23 | 56  | 2.6  |
| 23 TH             | - 0                  | 2 8   | -1402                    | - 0.63   | - 6.92                    | + 6 | 50.4 | + 21.1                   | 23 | 59  | 59.1 |
| 24 FR             | - 0                  | 25 31 | -1403                    | - 7.56   | - 6.92                    | + 7 | 11.5 | + 21.0                   | 0  | 3   | 55.7 |
| 25 SA             | - 0                  | 48 54 | -1403                    | - 14.49  | - 6.93                    | + 7 | 32.5 | + 20.8                   | 0  | 7   | 52.2 |
| 26 SU             | - 1                  | 12 17 | -1403                    | - 21.42  | - 6.93                    | + 7 | 53.3 | + 20.7                   | 0  | 11  | 48.8 |
| 27 MO             | - 1                  | 35 40 | -1403                    | - 28.34  | - 6.93                    | + 8 | 14.0 | + 20.5                   | 0  | 15  | 45.3 |
| 28 TU             | - 1                  | 59 2  | -1402                    | - 35.27  | - 6.92                    | + 8 | 34.6 | + 20.4                   | 0  | 19  | 41.8 |
| 29 WE             | - 2                  | 22 23 | -1401                    | - 42.19  | - 6.92                    | + 8 | 54.9 | + 20.2                   | 0  | 23  | 38.4 |
| 30 TH             | - 2                  | 45 43 | -1400                    | - 49.10  | - 6.91                    | + 9 | 15.1 | + 20.0                   | 0  | 27  | 35.0 |
|                   |                      |       | -1397                    | - 49.10  | - 6.91                    | + 9 | 35.1 | + 19.7                   | 0  | 31  | 31.5 |
|                   |                      |       |                          |          |                           | + 9 | 54.8 | + 19.5                   | 0  | 35  | 28.1 |

**Table 2. Sun, 1976 for Zero Hours Universal Time (GMT) — Continued**

| Greenwich<br>date | Apparent declination |    |    |                          |                           | Equation of time |      |                          | Sidereal time |     |      |
|-------------------|----------------------|----|----|--------------------------|---------------------------|------------------|------|--------------------------|---------------|-----|------|
|                   | Degrees              |    |    | Mils                     |                           | Min              | Sec  | Daily<br>change<br>(sec) | Hr            | Min | Sec  |
|                   | °                    | '  | "  | Daily<br>change<br>(sec) | Daily<br>change<br>(mils) |                  |      |                          |               |     |      |
| OCT 1 FR          | - 3                  | 9  | 0  | -1396                    | - 56.00 - 6.89            | +10              | 14.3 | + 19.2                   | 0             | 39  | 24.6 |
| 2 SA              | - 3                  | 32 | 16 | -1393                    | - 62.89 - 6.88            | +10              | 33.5 | + 18.9                   | 0             | 43  | 21.2 |
| 3 SU              | - 3                  | 55 | 29 | -1391                    | - 69.77 - 6.87            | +10              | 52.5 | + 18.6                   | 0             | 47  | 17.7 |
| 4 MO              | - 4                  | 18 | 40 | -1387                    | - 76.64 - 6.85            | +11              | 11.1 | + 18.3                   | 0             | 51  | 14.3 |
| 5 TU              | - 4                  | 41 | 47 | -1384                    | - 83.49 - 6.83            | +11              | 29.4 | + 17.9                   | 0             | 55  | 10.8 |
| 6 WE              | - 5                  | 4  | 51 | -1380                    | - 90.32 - 6.82            | +11              | 47.3 | + 17.6                   | 0             | 59  | 7.4  |
| 7 TH              | - 5                  | 27 | 51 | -1375                    | - 97.14 - 6.79            | +12              | 4.9  | + 17.1                   | 1             | 3   | 3.9  |
| 8 FR              | - 5                  | 50 | 46 | -1372                    | - 103.93 - 6.77           | +12              | 22.0 | + 16.7                   | 1             | 7   | 0.5  |
| 9 SA              | - 6                  | 13 | 38 | -1366                    | - 110.70 - 6.75           | +12              | 38.8 | + 16.3                   | 1             | 10  | 57.0 |
| 10 SU             | - 6                  | 36 | 24 | -1361                    | - 117.45 - 6.72           | +12              | 55.1 | + 15.8                   | 1             | 14  | 53.6 |
| 11 MO             | - 6                  | 59 | 5  | -1356                    | - 124.17 - 6.70           | +13              | 10.9 | + 15.3                   | 1             | 18  | 50.1 |
| 12 TU             | - 7                  | 21 | 41 | -1349                    | - 130.87 - 6.66           | +13              | 26.2 | + 14.8                   | 1             | 22  | 46.7 |
| 13 WE             | - 7                  | 44 | 10 | -1343                    | - 137.53 - 6.63           | +13              | 41.0 | + 14.3                   | 1             | 26  | 43.2 |
| 14 TH             | - 8                  | 6  | 33 | -1337                    | - 144.16 - 6.60           | +13              | 55.3 | + 13.7                   | 1             | 30  | 39.8 |
| 15 FR             | - 8                  | 28 | 50 | -1329                    | - 150.76 - 6.57           | +14              | 9.0  | + 13.1                   | 1             | 34  | 36.3 |
| 16 SA             | - 8                  | 50 | 59 | -1322                    | - 157.33 - 6.53           | +14              | 22.1 | + 12.6                   | 1             | 38  | 32.9 |
| 17 SU             | - 9                  | 13 | 1  | -1314                    | - 163.86 - 6.49           | +14              | 34.7 | + 11.9                   | 1             | 42  | 29.5 |
| 18 MO             | - 9                  | 34 | 55 | -1306                    | - 170.35 - 6.45           | +14              | 46.6 | + 11.3                   | 1             | 46  | 26.0 |
| 19 TU             | - 9                  | 56 | 41 | -1297                    | - 176.80 - 6.40           | +14              | 57.9 | + 10.7                   | 1             | 50  | 22.6 |
| 20 WE             | -10                  | 18 | 18 | -1288                    | - 183.20 - 6.36           | +15              | 8.6  | + 10.0                   | 1             | 54  | 19.1 |
| 21 TH             | -10                  | 39 | 46 | -1279                    | - 189.56 - 6.32           | +15              | 18.6 | + 9.3                    | 1             | 58  | 15.7 |
| 22 FR             | -11                  | 1  | 5  | -1269                    | - 195.88 - 6.26           | +15              | 27.9 | + 8.7                    | 2             | 2   | 12.2 |
| 23 SA             | -11                  | 22 | 14 | -1258                    | - 202.14 - 6.22           | +15              | 36.6 | + 8.0                    | 2             | 6   | 8.8  |
| 24 SU             | -11                  | 43 | 12 | -1248                    | - 208.36 - 6.16           | +15              | 44.5 | + 7.3                    | 2             | 10  | 5.3  |
| 25 MO             | -12                  | 4  | 0  | -1237                    | - 214.52 - 6.11           | +15              | 51.8 | + 6.6                    | 2             | 14  | 1.9  |
| 26 TU             | -12                  | 24 | 37 | -1225                    | - 220.63 - 6.05           | +15              | 58.4 | + 5.8                    | 2             | 17  | 58.4 |
| 27 WE             | -12                  | 45 | 2  | -1214                    | - 226.68 - 5.99           | +16              | 4.2  | + 5.1                    | 2             | 21  | 55.0 |
| 28 TH             | -13                  | 5  | 16 | -1200                    | - 232.67 - 5.93           | +16              | 9.4  | + 4.4                    | 2             | 25  | 51.5 |
| 29 FR             | -13                  | 25 | 16 | -1189                    | - 238.60 - 5.87           | +16              | 13.7 | + 3.6                    | 2             | 29  | 48.1 |
| 30 SA             | -13                  | 45 | 5  | -1175                    | - 244.47 - 5.80           | +16              | 17.4 | + 2.9                    | 2             | 33  | 44.7 |
| 31 SU             | -14                  | 4  | 40 | -1161                    | - 250.27 - 5.74           | +16              | 20.3 | + 2.1                    | 2             | 37  | 41.2 |



**Table 2. Sun, 1976 for Zero Hours Universal Time (GMT) — Continued**

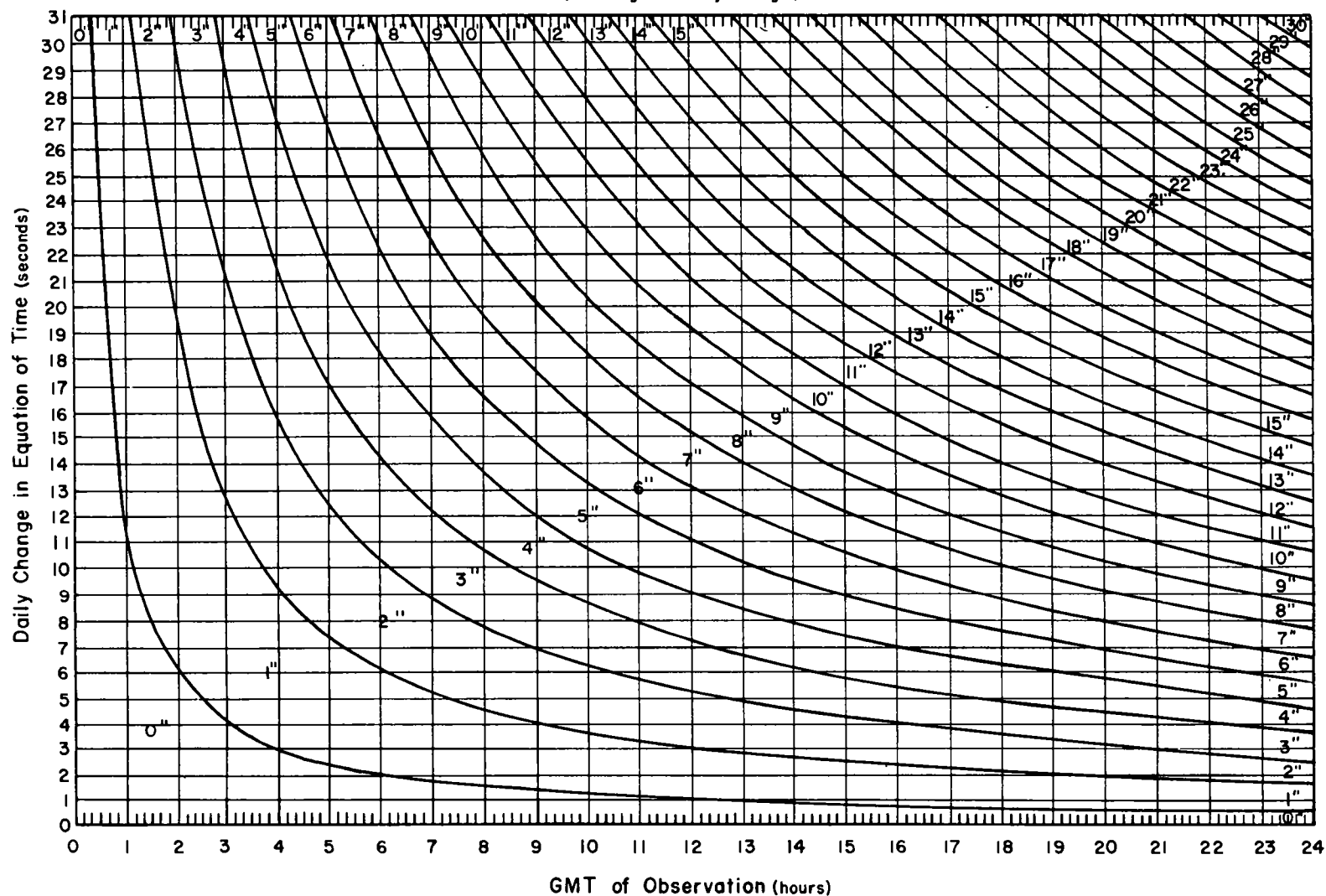
| Greenwich date |       | Apparent declination |    |      |                    | Equation of time |       |                    | Sidereal time |     |      |
|----------------|-------|----------------------|----|------|--------------------|------------------|-------|--------------------|---------------|-----|------|
|                |       | Degrees              |    | Mils |                    | Min              | Sec   | Daily change (sec) | Hr            | Min | Sec  |
|                |       | °                    | '  | ''   | Daily change (sec) |                  |       |                    |               |     |      |
| NOV            | 1 MO  | -14                  | 24 | 1    | -1148              | -256.01          | -5.66 | +16 22.4 + 1.3     | 2             | 41  | 37.8 |
|                | 2 TU  | -14                  | 43 | 9    | -1133              | -261.67          | -5.60 | +16 23.7 + 0.5     | 2             | 45  | 34.3 |
|                | 3 WE  | -15                  | 2  | 2    | -1118              | -267.27          | -5.52 | +16 24.2 - 0.3     | 2             | 49  | 30.9 |
|                | 4 TH  | -15                  | 20 | 40   | -1103              | -272.79          | -5.45 | +16 24.0 - 1.1     | 2             | 53  | 27.4 |
|                | 5 FR  | -15                  | 39 | 3    | -1088              | -278.24          | -5.37 | +16 22.9 - 1.9     | 2             | 57  | 24.0 |
|                | 6 SA  | -15                  | 57 | 11   | -1072              | -283.61          | -5.29 | +16 21.0 - 2.7     | 3             | 1   | 20.5 |
|                | 7 SU  | -16                  | 15 | 3    | -1056              | -288.90          | -5.22 | +16 18.3 - 3.6     | 3             | 5   | 17.1 |
|                | 8 MO  | -16                  | 32 | 39   | -1038              | -294.12          | -5.13 | +16 14.7 - 4.4     | 3             | 9   | 13.6 |
|                | 9 TU  | -16                  | 49 | 57   | -1022              | -299.25          | -5.04 | +16 10.3 - 5.3     | 3             | 13  | 10.2 |
|                | 10 WE | -17                  | 6  | 59   | -1004              | -304.29          | -4.96 | +16 5.0 - 6.1      | 3             | 17  | 6.7  |
|                | 11 TH | -17                  | 23 | 43   | -987               | -309.25          | -4.87 | +15 58.9 - 7.0     | 3             | 21  | 3.3  |
|                | 12 FR | -17                  | 40 | 10   | -968               | -314.12          | -4.78 | +15 51.9 - 7.8     | 3             | 24  | 59.9 |
|                | 13 SA | -17                  | 56 | 18   | -949               | -318.90          | -4.69 | +15 44.1 - 8.7     | 3             | 28  | 56.4 |
|                | 14 SU | -18                  | 12 | 7    | -930               | -323.59          | -4.59 | +15 35.4 - 9.6     | 3             | 32  | 53.0 |
|                | 15 MO | -18                  | 27 | 37   | -911               | -328.18          | -4.50 | +15 25.8 - 10.4    | 3             | 36  | 49.5 |
|                | 16 TU | -18                  | 42 | 48   | -891               | -332.68          | -4.40 | +15 15.3 - 11.3    | 3             | 40  | 46.1 |
|                | 17 WE | -18                  | 57 | 39   | -871               | -337.08          | -4.30 | +15 4.0 - 12.2     | 3             | 44  | 42.6 |
|                | 18 TH | -19                  | 12 | 10   | -850               | -341.38          | -4.20 | +14 51.9 - 13.0    | 3             | 48  | 39.2 |
|                | 19 FR | -19                  | 26 | 20   | -829               | -345.58          | -4.09 | +14 38.8 - 13.8    | 3             | 52  | 35.7 |
|                | 20 SA | -19                  | 40 | 9    | -807               | -349.67          | -3.99 | +14 25.0 - 14.7    | 3             | 56  | 32.3 |
|                | 21 SU | -19                  | 53 | 36   | -786               | -353.66          | -3.88 | +14 10.3 - 15.5    | 4             | 0   | 28.8 |
|                | 22 MO | -20                  | 6  | 42   | -764               | -357.54          | -3.77 | +13 54.8 - 16.3    | 4             | 4   | 25.4 |
|                | 23 TU | -20                  | 19 | 26   | -742               | -361.31          | -3.67 | +13 38.6 - 17.0    | 4             | 8   | 22.0 |
|                | 24 WE | -20                  | 31 | 48   | -718               | -364.98          | -3.54 | +13 21.5 - 17.8    | 4             | 12  | 18.5 |
|                | 25 TH | -20                  | 43 | 46   | -695               | -368.52          | -3.44 | +13 3.7 - 18.5     | 4             | 16  | 15.1 |
|                | 26 FR | -20                  | 55 | 21   | -672               | -371.96          | -3.32 | +12 45.2 - 19.3    | 4             | 20  | 11.6 |
|                | 27 SA | -21                  | 6  | 33   | -648               | -375.28          | -3.20 | +12 25.9 - 20.0    | 4             | 24  | 8.2  |
|                | 28 SU | -21                  | 17 | 21   | -624               | -378.48          | -3.08 | +12 5.9 - 20.6     | 4             | 28  | 4.8  |
|                | 29 MO | -21                  | 27 | 45   | -600               | -381.56          | -2.96 | +11 45.3 - 21.3    | 4             | 32  | 1.3  |
|                | 30 TU | -21                  | 37 | 45   | -574               | -384.52          | -2.83 | +11 24.0 - 22.0    | 4             | 35  | 57.9 |

**Table 2. Sun, 1976 for Zero Hours Universal Time (GMT) — Continued**

| Greenwich<br>date | Apparent declination |       |          |                           | Equation of time |      |                          | Sidereal time |     |      |
|-------------------|----------------------|-------|----------|---------------------------|------------------|------|--------------------------|---------------|-----|------|
|                   | Degrees              |       | Mils     |                           | Min              | Sec  | Daily<br>change<br>(sec) | Hr            | Min | Sec  |
|                   | °                    | ' "   | Mils     | Daily<br>change<br>(mils) |                  |      |                          |               |     |      |
| DEC 1 WE          | -21                  | 47 19 | - 387.35 |                           | +11              | 2.0  |                          | 4             | 39  | 54.4 |
| 2 TH              | -21                  | 56 29 | - 390.07 | - 2.72                    | +10              | 39.4 | - 22.6                   | 4             | 43  | 51.0 |
| 3 FR              | -22                  | 5 13  | - 392.66 | - 2.59                    | +10              | 16.2 | - 23.2                   | 4             | 47  | 47.5 |
| 4 SA              | -22                  | 13 32 | - 395.12 | - 2.46                    | + 9              | 52.4 | - 23.8                   | 4             | 51  | 44.1 |
| 5 SU              | -22                  | 21 24 | - 397.45 | - 2.33                    | + 9              | 28.0 | - 24.4                   | 4             | 55  | 40.6 |
| 6 MO              | -22                  | 28 51 | - 399.66 | - 2.21                    | + 9              | 3.1  | - 24.9                   | 4             | 59  | 37.2 |
| 7 TU              | -22                  | 35 52 | - 401.74 | - 2.08                    | + 8              | 37.7 | - 25.4                   | 5             | 3   | 33.8 |
| 8 WE              | -22                  | 42 26 | - 403.68 | - 1.94                    | + 8              | 11.7 | - 25.9                   | 5             | 7   | 30.3 |
| 9 TH              | -22                  | 48 33 | - 405.50 | - 1.82                    | + 7              | 45.3 | - 26.4                   | 5             | 11  | 26.9 |
| 10 FR             | -22                  | 54 13 | - 407.18 | - 1.68                    | + 7              | 18.4 | - 26.9                   | 5             | 15  | 23.4 |
| 11 SA             | -22                  | 59 26 | - 408.72 | - 1.54                    | + 6              | 51.1 | - 27.3                   | 5             | 19  | 20.0 |
| 12 SU             | -23                  | 4 12  | - 410.13 | - 1.41                    | + 6              | 23.4 | - 27.7                   | 5             | 23  | 16.5 |
| 13 MO             | -23                  | 8 31  | - 411.41 | - 1.28                    | + 5              | 55.3 | - 28.1                   | 5             | 27  | 13.1 |
| 14 TU             | -23                  | 12 22 | - 412.55 | - 1.14                    | + 5              | 26.9 | - 28.4                   | 5             | 31  | 9.7  |
| 15 WE             | -23                  | 15 45 | - 413.55 | - 1.00                    | + 4              | 58.1 | - 28.7                   | 5             | 35  | 6.2  |
| 16 TH             | -23                  | 18 40 | - 414.42 | - 0.87                    | + 4              | 29.1 | - 29.0                   | 5             | 39  | 2.8  |
| 17 FR             | -23                  | 21 7  | - 415.15 | - 0.73                    | + 3              | 59.8 | - 29.3                   | 5             | 42  | 59.3 |
| 18 SA             | -23                  | 23 7  | - 415.74 | - 0.59                    | + 3              | 30.3 | - 29.5                   | 5             | 46  | 55.9 |
| 19 SU             | -23                  | 24 38 | - 416.19 | - 0.45                    | + 3              | 0.7  | - 29.7                   | 5             | 50  | 52.4 |
| 20 MO             | -23                  | 25 41 | - 416.50 | - 0.31                    | + 2              | 30.8 | - 29.8                   | 5             | 54  | 49.0 |
| 21 TU             | -23                  | 26 15 | - 416.67 | - 0.17                    | + 2              | 0.9  | - 29.9                   | 5             | 58  | 45.6 |
| 22 WE             | -23                  | 26 22 | - 416.70 | - 0.03                    | + 1              | 31.0 | - 30.0                   | 6             | 2   | 42.1 |
| 23 TH             | -23                  | 26 0  | - 416.59 | + 0.11                    | + 1              | 1.0  | - 30.0                   | 6             | 6   | 38.7 |
| 24 FR             | -23                  | 25 10 | - 416.35 | + 0.24                    | + 0              | 31.0 | - 30.0                   | 6             | 10  | 35.2 |
| 25 SA             | -23                  | 23 52 | - 415.96 | + 0.39                    | + 0              | 1.1  | - 29.9                   | 6             | 14  | 31.8 |
| 26 SU             | -23                  | 22 6  | - 415.44 | + 0.52                    | - 0              | 28.7 | - 29.8                   | 6             | 18  | 28.4 |
| 27 MO             | -23                  | 19 51 | - 414.77 | + 0.67                    | - 0              | 58.4 | - 29.7                   | 6             | 22  | 24.9 |
| 28 TU             | -23                  | 17 9  | - 413.97 | + 0.80                    | - 1              | 27.9 | - 29.5                   | 6             | 26  | 21.5 |
| 29 WE             | -23                  | 13 58 | - 413.03 | + 0.94                    | - 1              | 57.2 | - 29.3                   | 6             | 30  | 18.0 |
| 30 TH             | -23                  | 10 19 | - 411.95 | + 1.08                    | - 2              | 26.3 | - 29.1                   | 6             | 34  | 14.6 |
| 31 FR             | -23                  | 6 13  | - 410.73 | + 1.22                    | - 2              | 55.1 | - 28.8                   | 6             | 38  | 11.1 |
| 32 SA             | -23                  | 1 39  | - 409.38 | + 1.35                    | - 3              | 23.7 | - 28.5                   | 6             | 42  | 7.7  |

**Table 3. Equation of Time Graph**  
**EQUATION OF TIME -- PARTIAL DAY IN SECONDS**

(Use sign of daily change.)



Note: Enter table with value of daily change to the nearest second and of GMT to the nearest 10 minutes. Do not interpolate for values more accurate than the nearest second.

Table 4. Correction to Greenwich Mean Time Interval to Obtain Greenwich Sidereal Time Interval

| GMT | 0 <sup>h</sup> | 1 <sup>h</sup> | 2 <sup>h</sup> | 3 <sup>h</sup> | 4 <sup>h</sup> | 5 <sup>h</sup> | 6 <sup>h</sup> | 7 <sup>h</sup> | 8 <sup>h</sup> | 9 <sup>h</sup> | 10 <sup>h</sup> | 11 <sup>h</sup> |
|-----|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-----------------|-----------------|
| m   | m s            | m s            | m s            | m s            | m s            | m s            | m s            | m s            | m s            | m s            | m s             | m s             |
| 0   | 0 0.0          | 0 0.0          | 0 19.7         | 0 29.6         | 0 39.4         | 0 49.3         | 0 59.1         | 1 9.0          | 1 18.9         | 1 28.7         | 1 38.6          | 1 48.4          |
| 1   | 0.2            | 10.0           | 19.9           | 29.7           | 39.6           | 49.4           | 59.3           | 9.2            | 19.0           | 28.9           | 38.7            | 48.6            |
| 2   | 0.3            | 10.2           | 20.0           | 29.9           | 39.8           | 49.6           | 59.5           | 9.3            | 19.2           | 29.0           | 38.9            | 48.8            |
| 3   | 0.5            | 10.3           | 20.2           | 30.1           | 39.9           | 49.8           | 59.6           | 9.5            | 19.3           | 29.2           | 39.1            | 48.9            |
| 4   | 0.7            | 10.5           | 20.4           | 30.2           | 40.1           | 49.9           | 59.8           | 9.7            | 19.5           | 29.4           | 39.2            | 49.1            |
| 5   | 0 0.8          | 0 10.7         | 0 20.5         | 0 30.4         | 0 40.2         | 0 50.1         | 1 0.0          | 1 9.8          | 1 19.7         | 1 29.5         | 1 39.4          | 1 49.2          |
| 6   | 1.0            | 10.8           | 20.7           | 30.6           | 40.4           | 50.3           | 0.1            | 10.0           | 19.8           | 29.7           | 39.6            | 49.4            |
| 7   | 1.2            | 11.0           | 20.9           | 30.7           | 40.6           | 50.4           | 0.3            | 10.1           | 20.0           | 29.9           | 39.7            | 49.6            |
| 8   | 1.3            | 11.2           | 21.0           | 30.9           | 40.7           | 50.6           | 0.5            | 10.3           | 20.2           | 30.0           | 39.9            | 49.7            |
| 9   | 1.5            | 11.3           | 21.2           | 31.0           | 40.9           | 50.8           | 0.6            | 10.5           | 20.3           | 30.2           | 40.0            | 49.9            |
| 10  | 0 1.6          | 0 11.5         | 0 21.4         | 0 31.2         | 0 41.1         | 0 50.9         | 1 0.8          | 1 10.6         | 1 20.5         | 1 30.4         | 1 40.2          | 1 50.1          |
| 11  | 1.8            | 11.7           | 21.5           | 31.4           | 41.2           | 51.1           | 0.9            | 10.8           | 20.7           | 30.5           | 40.4            | 50.2            |
| 12  | 2.0            | 11.8           | 21.7           | 31.5           | 41.4           | 51.3           | 1.1            | 11.0           | 20.8           | 30.7           | 40.5            | 50.4            |
| 13  | 2.1            | 12.0           | 21.8           | 31.7           | 41.6           | 51.4           | 1.3            | 11.1           | 21.0           | 30.8           | 40.7            | 50.6            |
| 14  | 2.3            | 12.2           | 22.0           | 31.9           | 41.7           | 51.6           | 1.4            | 11.3           | 21.2           | 31.0           | 40.9            | 50.7            |
| 15  | 0 2.5          | 0 12.3         | 0 22.2         | 0 32.0         | 0 41.9         | 0 51.7         | 1 1.6          | 1 11.5         | 1 21.3         | 1 31.2         | 1 41.0          | 1 50.9          |
| 16  | 2.6            | 12.5           | 22.3           | 32.2           | 42.1           | 51.9           | 1.8            | 11.6           | 21.5           | 31.3           | 41.2            | 51.0            |
| 17  | 2.8            | 12.6           | 22.5           | 32.4           | 42.2           | 52.1           | 1.9            | 11.8           | 21.6           | 31.5           | 41.4            | 51.2            |
| 18  | 3.0            | 12.8           | 22.7           | 32.5           | 42.4           | 52.2           | 2.1            | 12.0           | 21.8           | 31.7           | 41.5            | 51.4            |
| 19  | 3.1            | 13.0           | 22.8           | 32.7           | 42.5           | 52.4           | 2.3            | 12.1           | 22.0           | 31.8           | 41.7            | 51.5            |
| 20  | 0 3.3          | 0 13.1         | 0 23.0         | 0 32.9         | 0 42.7         | 0 52.6         | 1 2.4          | 1 12.3         | 1 22.1         | 1 32.0         | 1 41.8          | 1 51.7          |
| 21  | 3.4            | 13.3           | 23.2           | 33.0           | 42.9           | 52.7           | 2.6            | 12.4           | 22.3           | 32.2           | 42.0            | 51.9            |
| 22  | 3.6            | 13.5           | 23.3           | 33.2           | 43.0           | 52.9           | 2.8            | 12.6           | 22.5           | 32.3           | 42.2            | 52.0            |
| 23  | 3.8            | 13.6           | 23.5           | 33.3           | 43.2           | 53.1           | 2.9            | 12.8           | 22.6           | 32.5           | 42.3            | 52.2            |
| 24  | 3.9            | 13.8           | 23.7           | 33.5           | 43.4           | 53.2           | 3.1            | 12.9           | 22.8           | 32.7           | 42.5            | 52.4            |
| 25  | 0 4.1          | 0 14.0         | 0 23.8         | 0 33.7         | 0 43.5         | 0 53.4         | 1 3.2          | 1 13.1         | 1 23.0         | 1 32.8         | 1 42.7          | 1 52.5          |
| 26  | 4.3            | 14.1           | 24.0           | 33.8           | 43.7           | 53.6           | 3.4            | 13.3           | 23.1           | 33.0           | 42.8            | 52.7            |
| 27  | 4.4            | 14.3           | 24.1           | 34.0           | 43.9           | 53.7           | 3.6            | 13.4           | 23.3           | 33.1           | 43.0            | 52.9            |
| 28  | 4.6            | 14.5           | 24.3           | 34.2           | 44.0           | 53.9           | 3.7            | 13.6           | 23.5           | 33.3           | 43.2            | 53.0            |
| 29  | 4.8            | 14.6           | 24.5           | 34.3           | 44.2           | 54.0           | 3.9            | 13.8           | 23.6           | 33.5           | 43.3            | 53.2            |
| 30  | 0 4.9          | 0 14.8         | 0 24.6         | 0 34.5         | 0 44.4         | 0 54.2         | 1 4.1          | 1 13.9         | 1 23.8         | 1 33.6         | 1 43.5          | 1 53.3          |
| 31  | 5.1            | 14.9           | 24.8           | 34.7           | 44.5           | 54.4           | 4.2            | 14.1           | 23.9           | 33.8           | 43.7            | 53.5            |
| 32  | 5.3            | 15.1           | 25.0           | 34.8           | 44.7           | 54.5           | 4.4            | 14.3           | 24.1           | 34.0           | 43.8            | 53.7            |
| 33  | 5.4            | 15.3           | 25.1           | 35.0           | 44.8           | 54.7           | 4.6            | 14.4           | 24.3           | 34.1           | 44.0            | 53.8            |
| 34  | 5.6            | 15.4           | 25.3           | 35.2           | 45.0           | 54.9           | 4.7            | 14.6           | 24.4           | 34.3           | 44.2            | 54.0            |
| 35  | 0 5.8          | 0 15.6         | 0 25.5         | 0 35.3         | 0 45.2         | 0 55.0         | 1 4.9          | 1 14.7         | 1 24.6         | 1 34.5         | 1 44.3          | 1 54.2          |
| 36  | 5.9            | 15.8           | 25.6           | 35.5           | 45.3           | 55.2           | 5.1            | 14.9           | 24.8           | 34.6           | 44.5            | 54.3            |
| 37  | 6.1            | 15.9           | 25.8           | 35.6           | 45.5           | 55.4           | 5.2            | 15.1           | 24.9           | 34.8           | 44.6            | 54.5            |
| 38  | 6.2            | 16.1           | 26.0           | 35.8           | 45.7           | 55.5           | 5.4            | 15.2           | 25.1           | 35.0           | 44.8            | 54.7            |
| 39  | 6.4            | 16.3           | 26.1           | 36.0           | 45.8           | 55.7           | 5.5            | 15.4           | 25.3           | 35.1           | 45.0            | 54.8            |
| 40  | 0 6.6          | 0 16.4         | 0 26.3         | 0 36.1         | 0 46.0         | 0 55.9         | 1 5.7          | 1 15.6         | 1 25.4         | 1 35.3         | 1 45.1          | 1 55.0          |
| 41  | 6.7            | 16.6           | 26.4           | 36.3           | 46.2           | 56.0           | 5.9            | 15.7           | 25.6           | 35.4           | 45.3            | 55.2            |
| 42  | 6.9            | 16.8           | 26.6           | 36.5           | 46.3           | 56.2           | 6.0            | 15.9           | 25.8           | 35.6           | 45.5            | 55.3            |
| 43  | 7.1            | 16.9           | 26.8           | 36.6           | 46.5           | 56.3           | 6.2            | 16.1           | 25.9           | 35.8           | 45.6            | 55.5            |
| 44  | 7.2            | 17.1           | 26.9           | 36.8           | 46.7           | 56.5           | 6.4            | 16.2           | 26.1           | 35.9           | 45.8            | 55.6            |
| 45  | 0 7.4          | 0 17.2         | 0 27.1         | 0 37.0         | 0 46.8         | 0 56.7         | 1 6.5          | 1 16.4         | 1 26.2         | 1 36.1         | 1 46.0          | 1 55.8          |
| 46  | 7.6            | 17.4           | 27.3           | 37.1           | 47.0           | 56.8           | 6.7            | 16.6           | 26.4           | 36.3           | 46.1            | 56.0            |
| 47  | 7.7            | 17.6           | 27.4           | 37.3           | 47.1           | 57.0           | 6.9            | 16.7           | 26.6           | 36.4           | 46.3            | 56.1            |
| 48  | 7.9            | 17.7           | 27.6           | 37.5           | 47.3           | 57.2           | 7.0            | 16.9           | 26.7           | 36.6           | 46.4            | 56.3            |
| 49  | 8.0            | 17.9           | 27.8           | 37.6           | 47.5           | 57.3           | 7.2            | 17.0           | 26.9           | 36.8           | 46.6            | 56.5            |
| 50  | 0 8.2          | 0 18.1         | 0 27.9         | 0 37.8         | 0 47.6         | 0 57.5         | 1 7.4          | 1 17.2         | 1 27.1         | 1 36.9         | 1 46.8          | 1 56.6          |
| 51  | 8.4            | 18.2           | 28.1           | 37.9           | 47.8           | 57.7           | 7.5            | 17.4           | 27.2           | 37.1           | 46.9            | 56.8            |
| 52  | 8.5            | 18.4           | 28.3           | 38.1           | 48.0           | 57.8           | 7.7            | 17.5           | 27.4           | 37.3           | 47.1            | 57.0            |
| 53  | 8.7            | 18.6           | 28.4           | 38.3           | 48.1           | 58.0           | 7.8            | 17.7           | 27.6           | 37.4           | 47.3            | 57.1            |
| 54  | 8.9            | 18.7           | 28.6           | 38.4           | 48.3           | 58.2           | 8.0            | 17.9           | 27.7           | 37.6           | 47.4            | 57.3            |
| 55  | 0 9.0          | 0 18.9         | 0 28.7         | 0 38.6         | 0 48.5         | 0 58.3         | 1 8.2          | 1 18.0         | 1 27.9         | 1 37.7         | 1 47.6          | 1 57.5          |
| 56  | 9.2            | 19.1           | 28.9           | 38.8           | 48.6           | 58.5           | 8.3            | 18.2           | 28.1           | 37.9           | 47.8            | 57.6            |
| 57  | 9.4            | 19.2           | 29.1           | 38.9           | 48.8           | 58.6           | 8.5            | 18.4           | 28.2           | 38.1           | 47.9            | 57.8            |
| 58  | 9.5            | 19.4           | 29.2           | 39.1           | 49.0           | 58.8           | 8.7            | 18.5           | 28.4           | 38.2           | 48.1            | 57.9            |
| 59  | 9.7            | 19.5           | 29.4           | 39.3           | 49.1           | 59.0           | 8.8            | 18.7           | 28.5           | 38.4           | 48.3            | 58.1            |

Table 4. Correction to Greenwich Mean Time Interval to Obtain Greenwich Sidereal Time Interval—Continued

| GMT | 12 <sup>h</sup> | 13 <sup>h</sup> | 14 <sup>h</sup> | 15 <sup>h</sup> | 16 <sup>h</sup> | 17 <sup>h</sup> | 18 <sup>h</sup> | 19 <sup>h</sup> | 20 <sup>h</sup> | 21 <sup>h</sup> | 22 <sup>h</sup> | 23 <sup>h</sup> |
|-----|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| m   | m s             | m s             | m s             | m s             | m s             | m s             | m s             | m s             | m s             | m s             | m s             | m s             |
| 0   | 1 58.3          | 2 8.1           | 2 18.0          | 2 27.8          | 2 37.7          | 2 47.6          | 2 57.4          | 3 7.3           | 3 17.1          | 3 27.0          | 3 36.8          | 3 46.7          |
| 1   | 58.4            | 8.3             | 18.2            | 28.0            | 37.9            | 47.7            | 57.6            | 7.4             | 17.3            | 27.2            | 37.0            | 46.9            |
| 2   | 58.6            | 8.5             | 18.3            | 28.2            | 38.0            | 47.9            | 57.7            | 7.6             | 17.5            | 27.3            | 37.2            | 47.0            |
| 3   | 58.8            | 8.6             | 18.5            | 28.3            | 38.2            | 48.1            | 57.9            | 7.8             | 17.6            | 27.5            | 37.3            | 47.2            |
| 4   | 58.9            | 8.8             | 18.6            | 28.5            | 38.4            | 48.2            | 58.1            | 7.9             | 17.8            | 27.6            | 37.5            | 47.4            |
| 5   | 1 59.1          | 2 9.0           | 2 18.8          | 2 28.7          | 2 38.5          | 2 48.4          | 2 58.2          | 3 8.1           | 3 18.0          | 3 27.8          | 3 37.7          | 3 47.5          |
| 6   | 59.3            | 9.1             | 19.0            | 28.8            | 38.7            | 48.5            | 58.4            | 8.3             | 18.1            | 28.0            | 37.8            | 47.7            |
| 7   | 59.4            | 9.3             | 19.1            | 29.0            | 38.9            | 48.7            | 58.6            | 8.4             | 18.3            | 28.1            | 38.0            | 47.8            |
| 8   | 59.6            | 9.4             | 19.3            | 29.2            | 39.0            | 48.9            | 58.7            | 8.6             | 18.4            | 28.3            | 38.2            | 48.0            |
| 9   | 59.8            | 9.6             | 19.5            | 29.3            | 39.2            | 49.0            | 58.9            | 8.8             | 18.6            | 28.5            | 38.3            | 48.2            |
| 10  | 1 59.9          | 2 9.8           | 2 19.6          | 2 29.5          | 2 39.3          | 2 49.2          | 2 59.1          | 3 8.9           | 3 18.8          | 3 28.6          | 3 38.5          | 3 48.3          |
| 11  | 2 0.1           | 9.9             | 19.8            | 29.7            | 39.5            | 49.4            | 59.2            | 9.1             | 18.9            | 28.8            | 38.6            | 48.5            |
| 12  | 0.2             | 10.1            | 20.0            | 29.8            | 39.7            | 49.5            | 59.4            | 9.2             | 19.1            | 29.0            | 38.8            | 48.7            |
| 13  | 0.4             | 10.3            | 20.1            | 30.0            | 39.8            | 49.7            | 59.6            | 9.4             | 19.3            | 29.1            | 39.0            | 48.8            |
| 14  | 0.6             | 10.4            | 20.3            | 30.1            | 40.0            | 49.9            | 59.7            | 9.6             | 19.4            | 29.3            | 39.1            | 49.0            |
| 15  | 2 0.7           | 2 10.6          | 2 20.5          | 2 30.3          | 2 40.2          | 2 50.0          | 2 59.9          | 3 9.7           | 3 19.6          | 3 29.4          | 3 39.3          | 3 49.2          |
| 16  | 0.9             | 10.8            | 20.6            | 30.5            | 40.3            | 50.2            | 3 0.0           | 9.9             | 19.8            | 29.6            | 39.5            | 49.3            |
| 17  | 1.1             | 10.9            | 20.8            | 30.6            | 40.5            | 50.4            | 0.2             | 10.1            | 19.9            | 29.8            | 39.6            | 49.5            |
| 18  | 1.2             | 11.1            | 20.9            | 30.8            | 40.7            | 50.5            | 0.4             | 10.2            | 20.1            | 29.9            | 39.8            | 49.7            |
| 19  | 1.4             | 11.3            | 21.1            | 31.0            | 40.8            | 50.7            | 0.5             | 10.4            | 20.3            | 30.1            | 40.0            | 49.8            |
| 20  | 2 1.6           | 2 11.4          | 2 21.3          | 2 31.1          | 2 41.0          | 2 50.8          | 3 0.7           | 3 10.6          | 3 20.4          | 3 30.3          | 3 40.1          | 3 50.0          |
| 21  | 1.7             | 11.6            | 21.4            | 31.3            | 41.2            | 51.0            | 0.9             | 10.7            | 20.6            | 30.4            | 40.3            | 50.1            |
| 22  | 1.9             | 11.7            | 21.6            | 31.5            | 41.3            | 51.2            | 1.0             | 10.9            | 20.7            | 30.6            | 40.5            | 50.3            |
| 23  | 2.1             | 11.9            | 21.8            | 31.6            | 41.5            | 51.3            | 1.2             | 11.1            | 20.9            | 30.8            | 40.6            | 50.5            |
| 24  | 2.2             | 12.1            | 21.9            | 31.8            | 41.6            | 51.5            | 1.4             | 11.2            | 21.1            | 30.9            | 40.8            | 50.6            |
| 25  | 2 2.4           | 2 12.2          | 2 22.1          | 2 32.0          | 2 41.8          | 2 51.7          | 3 1.5           | 3 11.4          | 3 21.2          | 3 31.1          | 3 40.9          | 3 50.8          |
| 26  | 2.5             | 12.4            | 22.3            | 32.1            | 42.0            | 51.8            | 1.7             | 11.5            | 21.4            | 31.3            | 41.1            | 51.0            |
| 27  | 2.7             | 12.6            | 22.4            | 32.3            | 42.1            | 52.0            | 1.9             | 11.7            | 21.6            | 31.4            | 41.3            | 51.1            |
| 28  | 2.9             | 12.7            | 22.6            | 32.4            | 42.3            | 52.2            | 2.0             | 11.9            | 21.7            | 31.6            | 41.4            | 51.3            |
| 29  | 3.0             | 12.9            | 22.8            | 32.6            | 42.5            | 52.3            | 2.2             | 12.0            | 21.9            | 31.8            | 41.6            | 51.5            |
| 30  | 2 3.2           | 2 13.1          | 2 22.9          | 2 32.8          | 2 42.6          | 2 52.5          | 3 2.3           | 3 12.2          | 3 22.1          | 3 31.9          | 3 41.8          | 3 51.6          |
| 31  | 3.4             | 13.2            | 23.1            | 32.9            | 42.8            | 52.7            | 2.5             | 12.4            | 22.2            | 32.1            | 41.9            | 51.8            |
| 32  | 3.5             | 13.4            | 23.2            | 33.1            | 43.0            | 52.8            | 2.7             | 12.5            | 22.4            | 32.2            | 42.1            | 52.0            |
| 33  | 3.7             | 13.6            | 23.4            | 33.3            | 43.1            | 53.0            | 2.8             | 12.7            | 22.6            | 32.4            | 42.3            | 52.1            |
| 34  | 3.9             | 13.7            | 23.6            | 33.4            | 43.3            | 53.1            | 3.0             | 12.9            | 22.7            | 32.6            | 42.4            | 52.3            |
| 35  | 2 4.0           | 2 13.9          | 2 23.7          | 2 33.6          | 2 43.5          | 2 53.3          | 3 3.2           | 3 13.0          | 3 22.9          | 3 32.7          | 3 42.6          | 3 52.4          |
| 36  | 4.2             | 14.0            | 23.9            | 33.8            | 43.6            | 53.5            | 3.3             | 13.2            | 23.0            | 32.9            | 42.8            | 52.6            |
| 37  | 4.4             | 14.2            | 24.1            | 33.9            | 43.8            | 53.6            | 3.5             | 13.4            | 23.2            | 33.1            | 42.9            | 52.8            |
| 38  | 4.5             | 14.4            | 24.2            | 34.1            | 43.9            | 53.8            | 3.7             | 13.5            | 23.4            | 33.2            | 43.1            | 52.9            |
| 39  | 4.7             | 14.5            | 24.4            | 34.3            | 44.1            | 54.0            | 3.8             | 13.7            | 23.5            | 33.4            | 43.2            | 53.1            |
| 40  | 2 4.8           | 2 14.7          | 2 24.6          | 2 34.4          | 2 44.3          | 2 54.1          | 3 4.0           | 3 13.8          | 3 23.7          | 3 33.6          | 3 43.4          | 3 53.3          |
| 41  | 5.0             | 14.9            | 24.7            | 34.6            | 44.4            | 54.3            | 4.2             | 14.0            | 23.9            | 33.7            | 43.6            | 53.4            |
| 42  | 5.2             | 15.0            | 24.9            | 34.7            | 44.6            | 54.5            | 4.3             | 14.2            | 24.0            | 33.9            | 43.7            | 53.6            |
| 43  | 5.3             | 15.2            | 25.1            | 34.9            | 44.8            | 54.6            | 4.5             | 14.3            | 24.2            | 34.0            | 43.9            | 53.8            |
| 44  | 5.5             | 15.4            | 25.2            | 35.1            | 44.9            | 54.8            | 4.6             | 14.5            | 24.4            | 34.2            | 44.1            | 53.9            |
| 45  | 2 5.7           | 2 15.5          | 2 25.4          | 2 35.2          | 2 45.1          | 2 55.0          | 3 4.8           | 3 14.7          | 3 24.5          | 3 34.4          | 3 44.2          | 3 54.1          |
| 46  | 5.8             | 15.7            | 25.5            | 35.4            | 45.3            | 55.1            | 5.0             | 14.8            | 24.7            | 34.5            | 44.4            | 54.3            |
| 47  | 6.0             | 15.9            | 25.7            | 35.6            | 45.4            | 55.3            | 5.1             | 15.0            | 24.8            | 34.7            | 44.6            | 54.4            |
| 48  | 6.2             | 16.0            | 25.9            | 35.7            | 45.6            | 55.4            | 5.3             | 15.2            | 25.0            | 34.9            | 44.7            | 54.6            |
| 49  | 6.3             | 16.2            | 26.0            | 35.9            | 45.8            | 55.6            | 5.5             | 15.3            | 25.2            | 35.0            | 44.9            | 54.7            |
| 50  | 2 6.5           | 2 16.3          | 2 26.2          | 2 36.1          | 2 45.9          | 2 55.8          | 3 5.6           | 3 15.5          | 3 25.3          | 3 35.2          | 3 45.1          | 3 54.9          |
| 51  | 6.7             | 16.5            | 26.4            | 36.2            | 46.1            | 55.9            | 5.8             | 15.7            | 25.5            | 35.4            | 45.2            | 55.1            |
| 52  | 6.8             | 16.7            | 26.5            | 36.4            | 46.2            | 56.1            | 6.0             | 15.8            | 25.7            | 35.5            | 45.4            | 55.2            |
| 53  | 7.0             | 16.8            | 26.7            | 36.6            | 46.4            | 56.3            | 6.1             | 16.0            | 25.8            | 35.7            | 45.5            | 55.4            |
| 54  | 7.1             | 17.0            | 26.9            | 36.7            | 46.6            | 56.4            | 6.3             | 16.1            | 26.0            | 35.9            | 45.7            | 55.6            |
| 55  | 2 7.3           | 2 17.2          | 2 27.0          | 2 36.9          | 2 46.7          | 2 56.6          | 3 6.5           | 3 16.3          | 3 26.2          | 3 36.0          | 3 45.9          | 3 55.7          |
| 56  | 7.5             | 17.3            | 27.2            | 37.0            | 46.9            | 56.8            | 6.6             | 16.5            | 26.3            | 36.2            | 46.0            | 55.9            |
| 57  | 7.6             | 17.5            | 27.4            | 37.2            | 47.1            | 56.9            | 6.8             | 16.6            | 26.5            | 36.4            | 46.2            | 56.1            |
| 58  | 7.8             | 17.7            | 27.5            | 37.4            | 47.2            | 57.1            | 6.9             | 16.8            | 26.7            | 36.5            | 46.4            | 56.2            |
| 59  | 8.0             | 17.8            | 27.7            | 37.5            | 47.4            | 57.3            | 7.1             | 17.0            | 26.8            | 36.7            | 46.5            | 56.4            |

Table 5a. Conversion of Time to Arc

| Time  |     |         | Arc |   |      | Time  |    |      | Arc |        |      | Time |    |        | Arc |   |      |
|-------|-----|---------|-----|---|------|-------|----|------|-----|--------|------|------|----|--------|-----|---|------|
| Hours | '   | Mils    | Min | ' | Mils | Min   | '  | Mils | Min | '      | Mils | Min  | '  | Mils   | Min | ' | Mils |
| 1     | 15  | 266.67  | 1   | 0 | 15   | 4.44  | 21 | 5    | 15  | 98.33  | 41   | 10   | 15 | 182.22 |     |   |      |
| 2     | 30  | 533.33  | 2   | 0 | 30   | 8.89  | 22 | 5    | 30  | 97.78  | 42   | 10   | 30 | 186.67 |     |   |      |
| 3     | 45  | 800.00  | 3   | 0 | 45   | 13.33 | 23 | 5    | 45  | 102.22 | 43   | 10   | 45 | 191.11 |     |   |      |
| 4     | 60  | 1066.67 | 4   | 1 | 00   | 17.78 | 24 | 6    | 00  | 106.67 | 44   | 11   | 00 | 195.56 |     |   |      |
| 5     | 75  | 1333.33 | 5   | 1 | 15   | 22.22 | 25 | 6    | 15  | 111.11 | 45   | 11   | 15 | 200.00 |     |   |      |
| 6     | 90  | 1600.00 | 6   | 1 | 30   | 26.67 | 26 | 6    | 30  | 115.56 | 46   | 11   | 30 | 204.44 |     |   |      |
| 7     | 105 | 1866.67 | 7   | 1 | 45   | 31.11 | 27 | 6    | 45  | 120.00 | 47   | 11   | 45 | 208.89 |     |   |      |
| 8     | 120 | 2133.33 | 8   | 2 | 00   | 35.56 | 28 | 7    | 00  | 124.44 | 48   | 12   | 00 | 213.33 |     |   |      |
| 9     | 135 | 2400.00 | 9   | 2 | 15   | 40.00 | 29 | 7    | 15  | 128.89 | 49   | 12   | 15 | 217.78 |     |   |      |
| 10    | 150 | 2666.67 | 10  | 2 | 30   | 44.44 | 30 | 7    | 30  | 133.33 | 50   | 12   | 30 | 222.22 |     |   |      |
| 11    | 165 | 2933.33 | 11  | 2 | 45   | 48.89 | 31 | 7    | 45  | 137.78 | 51   | 12   | 45 | 226.67 |     |   |      |
| 12    | 180 | 3200.00 | 12  | 3 | 00   | 53.33 | 32 | 8    | 00  | 142.22 | 52   | 13   | 00 | 231.11 |     |   |      |
| 13    | 195 | 3466.67 | 13  | 3 | 15   | 57.78 | 33 | 8    | 15  | 146.67 | 53   | 13   | 15 | 235.56 |     |   |      |
| 14    | 210 | 3733.33 | 14  | 3 | 30   | 62.22 | 34 | 8    | 30  | 151.11 | 54   | 13   | 30 | 240.00 |     |   |      |
| 15    | 225 | 4000.00 | 15  | 3 | 45   | 66.67 | 35 | 8    | 45  | 155.56 | 55   | 13   | 45 | 244.44 |     |   |      |
| 16    | 240 | 4266.67 | 16  | 4 | 00   | 71.11 | 36 | 9    | 00  | 160.00 | 56   | 14   | 00 | 248.89 |     |   |      |
| 17    | 255 | 4533.33 | 17  | 4 | 15   | 75.56 | 37 | 9    | 15  | 164.44 | 57   | 14   | 15 | 253.33 |     |   |      |
| 18    | 270 | 4800.00 | 18  | 4 | 30   | 80.00 | 38 | 9    | 30  | 168.89 | 58   | 14   | 30 | 257.78 |     |   |      |
| 19    | 285 | 5066.67 | 19  | 4 | 45   | 84.44 | 39 | 9    | 45  | 173.33 | 59   | 14   | 45 | 262.22 |     |   |      |
| 20    | 300 | 5333.33 | 20  | 5 | 00   | 88.89 | 40 | 10   | 00  | 177.78 | 60   | 15   | 00 | 266.67 |     |   |      |
| 21    | 315 | 5600.00 |     |   |      |       |    |      |     |        |      |      |    |        |     |   |      |
| 22    | 330 | 5866.67 |     |   |      |       |    |      |     |        |      |      |    |        |     |   |      |
| 23    | 345 | 6133.33 |     |   |      |       |    |      |     |        |      |      |    |        |     |   |      |
| 24    | 360 | 6400.00 |     |   |      |       |    |      |     |        |      |      |    |        |     |   |      |

| Time |   |    |      | Arc |   |    |      | Time |    |    |      | Arc |    |    |      | Time |   |   |      | Arc |   |   |      |
|------|---|----|------|-----|---|----|------|------|----|----|------|-----|----|----|------|------|---|---|------|-----|---|---|------|
| Sec  | ' | '  | Mils | Sec | ' | '  | Mils | Sec  | '  | '  | Mils | Sec | '  | '  | Mils | Sec  | ' | ' | Mils | Sec | ' | ' | Mils |
| 1    | 0 | 15 | .07  | 16  | 4 | 00 | 1.19 | 31   | 7  | 45 | 2.30 | 46  | 11 | 30 | 3.41 |      |   |   |      |     |   |   |      |
| 2    | 0 | 30 | .15  | 17  | 4 | 15 | 1.26 | 32   | 8  | 00 | 2.37 | 47  | 11 | 45 | 3.48 |      |   |   |      |     |   |   |      |
| 3    | 0 | 45 | .22  | 18  | 4 | 30 | 1.33 | 33   | 8  | 15 | 2.44 | 48  | 12 | 00 | 3.56 |      |   |   |      |     |   |   |      |
| 4    | 1 | 00 | .30  | 19  | 4 | 45 | 1.41 | 34   | 8  | 30 | 2.52 | 49  | 12 | 15 | 3.63 |      |   |   |      |     |   |   |      |
| 5    | 1 | 15 | .37  | 20  | 5 | 00 | 1.48 | 35   | 8  | 45 | 2.59 | 50  | 12 | 30 | 3.70 |      |   |   |      |     |   |   |      |
| 6    | 1 | 30 | .44  | 21  | 5 | 15 | 1.56 | 36   | 9  | 00 | 2.67 | 51  | 12 | 45 | 3.78 |      |   |   |      |     |   |   |      |
| 7    | 1 | 45 | .52  | 22  | 5 | 30 | 1.63 | 37   | 9  | 15 | 2.74 | 52  | 13 | 00 | 3.85 |      |   |   |      |     |   |   |      |
| 8    | 2 | 00 | .59  | 23  | 5 | 45 | 1.70 | 37   | 9  | 30 | 2.81 | 53  | 13 | 15 | 3.93 |      |   |   |      |     |   |   |      |
| 9    | 2 | 15 | .67  | 24  | 6 | 00 | 1.78 | 39   | 9  | 45 | 2.89 | 54  | 13 | 30 | 4.00 |      |   |   |      |     |   |   |      |
| 10   | 2 | 30 | .74  | 25  | 6 | 15 | 1.85 | 40   | 10 | 00 | 2.96 | 55  | 13 | 45 | 4.07 |      |   |   |      |     |   |   |      |
| 11   | 2 | 45 | .81  | 26  | 6 | 30 | 1.93 | 41   | 10 | 15 | 3.04 | 56  | 14 | 00 | 4.15 |      |   |   |      |     |   |   |      |
| 12   | 3 | 00 | .89  | 27  | 6 | 45 | 2.00 | 42   | 10 | 30 | 3.11 | 57  | 14 | 15 | 4.22 |      |   |   |      |     |   |   |      |
| 13   | 3 | 15 | .96  | 28  | 7 | 00 | 2.07 | 43   | 10 | 45 | 3.19 | 58  | 14 | 30 | 4.30 |      |   |   |      |     |   |   |      |
| 14   | 3 | 30 | 1.04 | 29  | 7 | 15 | 2.15 | 44   | 11 | 00 | 3.26 | 59  | 14 | 45 | 4.37 |      |   |   |      |     |   |   |      |
| 15   | 3 | 45 | 1.11 | 30  | 7 | 30 | 2.22 | 45   | 11 | 15 | 3.33 | 60  | 15 | 00 | 4.44 |      |   |   |      |     |   |   |      |

Example: Time is 22 hours, 46 minutes, 37 seconds. Convert to arc.

22 hours time = 330° arc

46 minutes time = 11° 30' arc

37 seconds time = 9' 15" arc

22° 46' 37" 341° 39' 15" arc

Table 5b. Conversion of Arc to Time

| DEGREES |   |    |     |   |    | MINUTES |    |    | SECONDS |   |    |    |   |    |
|---------|---|----|-----|---|----|---------|----|----|---------|---|----|----|---|----|
| °       | ' | "  | °   | ' | "  | °       | '  | "  | °       | ' | "  | °  | ' | "  |
| 0       | 0 | 00 | 60  | 4 | 00 | 120     | 8  | 00 | 0       | 0 | 00 | 0  | 0 | 00 |
| 1       | 0 | 04 | 61  | 4 | 04 | 121     | 8  | 04 | 1       | 0 | 04 | 1  | 0 | 04 |
| 2       | 0 | 08 | 62  | 4 | 08 | 122     | 8  | 08 | 2       | 0 | 08 | 2  | 0 | 08 |
| 3       | 0 | 12 | 63  | 4 | 12 | 123     | 8  | 12 | 3       | 0 | 12 | 3  | 0 | 12 |
| 4       | 0 | 16 | 64  | 4 | 16 | 124     | 8  | 16 | 4       | 0 | 16 | 4  | 0 | 16 |
| 5       | 0 | 20 | 65  | 4 | 20 | 125     | 8  | 20 | 5       | 0 | 20 | 5  | 0 | 20 |
| 6       | 0 | 24 | 66  | 4 | 24 | 126     | 8  | 24 | 6       | 0 | 24 | 6  | 0 | 24 |
| 7       | 0 | 28 | 67  | 4 | 28 | 127     | 8  | 28 | 7       | 0 | 28 | 7  | 0 | 28 |
| 8       | 0 | 32 | 68  | 4 | 32 | 128     | 8  | 32 | 8       | 0 | 32 | 8  | 0 | 32 |
| 9       | 0 | 36 | 69  | 4 | 36 | 129     | 8  | 36 | 9       | 0 | 36 | 9  | 0 | 36 |
| 10      | 0 | 40 | 70  | 4 | 40 | 130     | 8  | 40 | 10      | 0 | 40 | 10 | 0 | 40 |
| 11      | 0 | 44 | 71  | 4 | 44 | 131     | 8  | 44 | 11      | 0 | 44 | 11 | 0 | 44 |
| 12      | 0 | 48 | 72  | 4 | 48 | 132     | 8  | 48 | 12      | 0 | 48 | 12 | 0 | 48 |
| 13      | 0 | 52 | 73  | 4 | 52 | 133     | 8  | 52 | 13      | 0 | 52 | 13 | 0 | 52 |
| 14      | 0 | 56 | 74  | 4 | 56 | 134     | 8  | 56 | 14      | 0 | 56 | 14 | 0 | 56 |
| 15      | 1 | 00 | 75  | 5 | 00 | 135     | 9  | 00 | 15      | 1 | 00 | 15 | 1 | 00 |
| 16      | 1 | 04 | 76  | 5 | 04 | 136     | 9  | 04 | 16      | 1 | 04 | 16 | 1 | 04 |
| 17      | 1 | 08 | 77  | 5 | 08 | 137     | 9  | 08 | 17      | 1 | 08 | 17 | 1 | 08 |
| 18      | 1 | 12 | 78  | 5 | 12 | 138     | 9  | 12 | 18      | 1 | 12 | 18 | 1 | 12 |
| 19      | 1 | 16 | 79  | 5 | 16 | 139     | 9  | 16 | 19      | 1 | 16 | 19 | 1 | 16 |
| 20      | 1 | 20 | 80  | 5 | 20 | 140     | 9  | 20 | 20      | 1 | 20 | 20 | 1 | 20 |
| 21      | 1 | 24 | 81  | 5 | 24 | 141     | 9  | 24 | 21      | 1 | 24 | 21 | 1 | 24 |
| 22      | 1 | 28 | 82  | 5 | 28 | 142     | 9  | 28 | 22      | 1 | 28 | 22 | 1 | 28 |
| 23      | 1 | 32 | 83  | 5 | 32 | 143     | 9  | 32 | 23      | 1 | 32 | 23 | 1 | 32 |
| 24      | 1 | 36 | 84  | 5 | 36 | 144     | 9  | 36 | 24      | 1 | 36 | 24 | 1 | 36 |
| 25      | 1 | 40 | 85  | 5 | 40 | 145     | 9  | 40 | 25      | 1 | 40 | 25 | 1 | 40 |
| 26      | 1 | 44 | 86  | 5 | 44 | 146     | 9  | 44 | 26      | 1 | 44 | 26 | 1 | 44 |
| 27      | 1 | 48 | 87  | 5 | 48 | 147     | 9  | 48 | 27      | 1 | 48 | 27 | 1 | 48 |
| 28      | 1 | 52 | 88  | 5 | 52 | 148     | 9  | 52 | 28      | 1 | 52 | 28 | 1 | 52 |
| 29      | 1 | 56 | 89  | 5 | 56 | 149     | 9  | 56 | 29      | 1 | 56 | 29 | 1 | 56 |
| 30      | 2 | 00 | 90  | 6 | 00 | 150     | 10 | 00 | 30      | 2 | 00 | 30 | 2 | 00 |
| 31      | 2 | 04 | 91  | 6 | 04 | 151     | 10 | 04 | 31      | 2 | 04 | 31 | 2 | 04 |
| 32      | 2 | 08 | 92  | 6 | 08 | 152     | 10 | 08 | 32      | 2 | 08 | 32 | 2 | 08 |
| 33      | 2 | 12 | 93  | 6 | 12 | 153     | 10 | 12 | 33      | 2 | 12 | 33 | 2 | 12 |
| 34      | 2 | 16 | 94  | 6 | 16 | 154     | 10 | 16 | 34      | 2 | 16 | 34 | 2 | 16 |
| 35      | 2 | 20 | 95  | 6 | 20 | 155     | 10 | 20 | 35      | 2 | 20 | 35 | 2 | 20 |
| 36      | 2 | 24 | 96  | 6 | 24 | 156     | 10 | 24 | 36      | 2 | 24 | 36 | 2 | 24 |
| 37      | 2 | 28 | 97  | 6 | 28 | 157     | 10 | 28 | 37      | 2 | 28 | 37 | 2 | 28 |
| 38      | 2 | 32 | 98  | 6 | 32 | 158     | 10 | 32 | 38      | 2 | 32 | 38 | 2 | 32 |
| 39      | 2 | 36 | 99  | 6 | 36 | 159     | 10 | 36 | 39      | 2 | 36 | 39 | 2 | 36 |
| 40      | 2 | 40 | 100 | 6 | 40 | 160     | 10 | 40 | 40      | 2 | 40 | 40 | 2 | 40 |
| 41      | 2 | 44 | 101 | 6 | 44 | 161     | 10 | 44 | 41      | 2 | 44 | 41 | 2 | 44 |
| 42      | 2 | 48 | 102 | 6 | 48 | 162     | 10 | 48 | 42      | 2 | 48 | 42 | 2 | 48 |
| 43      | 2 | 52 | 103 | 6 | 52 | 163     | 10 | 52 | 43      | 2 | 52 | 43 | 2 | 52 |
| 44      | 2 | 56 | 104 | 6 | 56 | 164     | 10 | 56 | 44      | 2 | 56 | 44 | 2 | 56 |
| 45      | 3 | 00 | 105 | 7 | 00 | 165     | 11 | 00 | 45      | 3 | 00 | 45 | 3 | 00 |
| 46      | 3 | 04 | 106 | 7 | 04 | 166     | 11 | 04 | 46      | 3 | 04 | 46 | 3 | 04 |
| 47      | 3 | 08 | 107 | 7 | 08 | 167     | 11 | 08 | 47      | 3 | 08 | 47 | 3 | 08 |
| 48      | 3 | 12 | 108 | 7 | 12 | 168     | 11 | 12 | 48      | 3 | 12 | 48 | 3 | 12 |
| 49      | 3 | 16 | 109 | 7 | 16 | 169     | 11 | 16 | 49      | 3 | 16 | 49 | 3 | 16 |
| 50      | 3 | 20 | 110 | 7 | 20 | 170     | 11 | 20 | 50      | 3 | 20 | 50 | 3 | 20 |
| 51      | 3 | 24 | 111 | 7 | 24 | 171     | 11 | 24 | 51      | 3 | 24 | 51 | 3 | 24 |
| 52      | 3 | 28 | 112 | 7 | 28 | 172     | 11 | 28 | 52      | 3 | 28 | 52 | 3 | 28 |
| 53      | 3 | 32 | 113 | 7 | 32 | 173     | 11 | 32 | 53      | 3 | 32 | 53 | 3 | 32 |
| 54      | 3 | 36 | 114 | 7 | 36 | 174     | 11 | 36 | 54      | 3 | 36 | 54 | 3 | 36 |
| 55      | 3 | 40 | 115 | 7 | 40 | 175     | 11 | 40 | 55      | 3 | 40 | 55 | 3 | 40 |
| 56      | 3 | 44 | 116 | 7 | 44 | 176     | 11 | 44 | 56      | 3 | 44 | 56 | 3 | 44 |
| 57      | 3 | 48 | 117 | 7 | 48 | 177     | 11 | 48 | 57      | 3 | 48 | 57 | 3 | 48 |
| 58      | 3 | 52 | 118 | 7 | 52 | 178     | 11 | 52 | 58      | 3 | 52 | 58 | 3 | 52 |
| 59      | 3 | 56 | 119 | 7 | 56 | 179     | 11 | 56 | 59      | 3 | 56 | 59 | 3 | 56 |

90° - 6°

180° - 12°

270° - 18°

Table 5c. Conversion of Degrees, Minutes, and Seconds to Mils

| Degrees |        |     |         |     |         |     |         |     |         |     |         |
|---------|--------|-----|---------|-----|---------|-----|---------|-----|---------|-----|---------|
| Deg     | Mils   | Deg | Mils    | Deg | Mils    | Deg | Mils    | Deg | Mils    | Deg | Mils    |
| 1       | 17.78  | 31  | 551.11  | 61  | 1084.44 | 91  | 1617.78 | 121 | 2151.11 | 151 | 2684.44 |
| 2       | 35.56  | 32  | 568.89  | 62  | 1102.22 | 92  | 1635.56 | 122 | 2168.89 | 152 | 2702.22 |
| 3       | 53.33  | 33  | 586.67  | 63  | 1120.00 | 93  | 1653.33 | 123 | 2186.67 | 153 | 2720.00 |
| 4       | 71.11  | 34  | 604.44  | 64  | 1137.78 | 94  | 1671.11 | 124 | 2204.44 | 154 | 2737.78 |
| 5       | 88.89  | 35  | 622.22  | 65  | 1155.56 | 95  | 1688.89 | 125 | 2222.22 | 155 | 2755.56 |
| 6       | 106.67 | 36  | 640.00  | 66  | 1173.33 | 96  | 1706.67 | 126 | 2240.00 | 156 | 2773.33 |
| 7       | 124.44 | 37  | 657.78  | 67  | 1191.11 | 97  | 1724.44 | 127 | 2257.78 | 157 | 2791.11 |
| 8       | 142.22 | 38  | 675.56  | 68  | 1208.89 | 98  | 1742.22 | 128 | 2275.56 | 158 | 2808.89 |
| 9       | 160.00 | 39  | 693.33  | 69  | 1226.67 | 99  | 1760.00 | 129 | 2293.33 | 159 | 2826.67 |
| 10      | 177.78 | 40  | 711.11  | 70  | 1244.44 | 100 | 1777.78 | 130 | 2311.11 | 160 | 2844.44 |
| 11      | 195.56 | 41  | 728.89  | 71  | 1262.22 | 101 | 1795.56 | 131 | 2328.89 | 161 | 2862.22 |
| 12      | 213.33 | 42  | 746.67  | 72  | 1280.00 | 102 | 1813.33 | 132 | 2346.67 | 162 | 2880.00 |
| 13      | 231.11 | 43  | 764.44  | 73  | 1297.78 | 103 | 1831.11 | 133 | 2364.44 | 163 | 2897.78 |
| 14      | 248.89 | 44  | 782.22  | 74  | 1315.56 | 104 | 1848.89 | 134 | 2382.22 | 164 | 2915.56 |
| 15      | 266.67 | 45  | 800.00  | 75  | 1333.33 | 105 | 1866.67 | 135 | 2400.00 | 165 | 2933.33 |
| 16      | 284.44 | 46  | 817.78  | 76  | 1351.11 | 106 | 1884.44 | 136 | 2417.78 | 166 | 2951.11 |
| 17      | 302.22 | 47  | 835.56  | 77  | 1368.89 | 107 | 1902.22 | 137 | 2435.56 | 167 | 2968.89 |
| 18      | 320.00 | 48  | 853.33  | 78  | 1386.67 | 108 | 1920.00 | 138 | 2453.33 | 168 | 2986.67 |
| 19      | 337.78 | 49  | 871.11  | 79  | 1404.44 | 109 | 1937.78 | 139 | 2471.11 | 169 | 3004.44 |
| 20      | 355.56 | 50  | 888.89  | 80  | 1422.22 | 110 | 1955.56 | 140 | 2488.89 | 170 | 3022.22 |
| 21      | 373.33 | 51  | 906.67  | 81  | 1440.00 | 111 | 1973.33 | 141 | 2506.67 | 171 | 3040.00 |
| 22      | 391.11 | 52  | 924.44  | 82  | 1457.78 | 112 | 1991.11 | 142 | 2524.44 | 172 | 3057.78 |
| 23      | 408.89 | 53  | 942.22  | 83  | 1475.56 | 113 | 2008.89 | 143 | 2542.22 | 173 | 3075.56 |
| 24      | 426.67 | 54  | 960.00  | 84  | 1493.33 | 114 | 2026.67 | 144 | 2560.00 | 174 | 3093.33 |
| 25      | 444.44 | 55  | 977.78  | 85  | 1511.11 | 115 | 2044.44 | 145 | 2577.78 | 175 | 3111.11 |
| 26      | 462.22 | 56  | 995.56  | 86  | 1528.89 | 116 | 2062.22 | 146 | 2595.56 | 176 | 3128.89 |
| 27      | 480.00 | 57  | 1013.33 | 87  | 1546.67 | 117 | 2080.00 | 147 | 2613.33 | 177 | 3146.67 |
| 28      | 497.78 | 58  | 1031.11 | 88  | 1564.44 | 118 | 2097.78 | 148 | 2631.11 | 178 | 3164.44 |
| 29      | 515.56 | 59  | 1048.89 | 89  | 1582.22 | 119 | 2115.56 | 149 | 2648.89 | 179 | 3182.22 |
| 30      | 533.33 | 60  | 1066.67 | 90  | 1600.00 | 120 | 2133.33 | 150 | 2666.67 | 180 | 3200.00 |

| Minutes |      |     |       |     |       | Seconds |      |     |      |     |      |
|---------|------|-----|-------|-----|-------|---------|------|-----|------|-----|------|
| Min     | Mils | Min | Mils  | Min | Mils  | Sec     | Mils | Sec | Mils | Sec | Mils |
| 1       | 0.30 | 21  | 6.22  | 41  | 12.15 | 1       | 0.00 | 21  | 0.10 | 41  | 0.20 |
| 2       | 0.59 | 22  | 6.52  | 42  | 12.44 | 2       | 0.01 | 22  | 0.11 | 42  | 0.21 |
| 3       | 0.89 | 23  | 6.81  | 43  | 12.74 | 3       | 0.01 | 23  | 0.11 | 43  | 0.21 |
| 4       | 1.19 | 24  | 7.11  | 44  | 13.04 | 4       | 0.02 | 24  | 0.12 | 44  | 0.22 |
| 5       | 1.48 | 25  | 7.41  | 45  | 13.33 | 5       | 0.02 | 25  | 0.12 | 45  | 0.22 |
| 6       | 1.78 | 26  | 7.70  | 46  | 13.63 | 6       | 0.03 | 26  | 0.13 | 46  | 0.23 |
| 7       | 2.07 | 27  | 8.00  | 47  | 13.93 | 7       | 0.03 | 27  | 0.13 | 47  | 0.23 |
| 8       | 2.37 | 28  | 8.30  | 48  | 14.22 | 8       | 0.04 | 28  | 0.14 | 48  | 0.24 |
| 9       | 2.67 | 29  | 8.59  | 49  | 14.52 | 9       | 0.04 | 29  | 0.14 | 49  | 0.24 |
| 10      | 2.96 | 30  | 8.89  | 50  | 14.81 | 10      | 0.05 | 30  | 0.15 | 50  | 0.25 |
| 11      | 3.26 | 31  | 9.19  | 51  | 15.11 | 11      | 0.05 | 31  | 0.15 | 51  | 0.25 |
| 12      | 3.56 | 32  | 9.48  | 52  | 15.41 | 12      | 0.06 | 32  | 0.16 | 52  | 0.26 |
| 13      | 3.85 | 33  | 9.78  | 53  | 15.70 | 13      | 0.06 | 33  | 0.16 | 53  | 0.26 |
| 14      | 4.15 | 34  | 10.07 | 54  | 16.00 | 14      | 0.07 | 34  | 0.17 | 54  | 0.27 |
| 15      | 4.44 | 35  | 10.37 | 55  | 16.30 | 15      | 0.07 | 35  | 0.17 | 55  | 0.27 |
| 16      | 4.74 | 36  | 10.67 | 56  | 16.59 | 16      | 0.08 | 36  | 0.18 | 56  | 0.28 |
| 17      | 5.04 | 37  | 10.96 | 57  | 16.89 | 17      | 0.08 | 37  | 0.18 | 57  | 0.28 |
| 18      | 5.33 | 38  | 11.26 | 58  | 17.19 | 18      | 0.09 | 38  | 0.19 | 58  | 0.29 |
| 19      | 5.63 | 39  | 11.56 | 59  | 17.48 | 19      | 0.09 | 39  | 0.19 | 59  | 0.29 |
| 20      | 5.93 | 40  | 11.85 | 60  | 17.78 | 20      | 0.10 | 40  | 0.20 | 60  | 0.30 |



Table 6. Convergence

Northing = UTM grid northing coordinate of station in meters.

If in Northern Hemisphere, enter table with northing.

If in Southern Hemisphere, subtract northing of station from 10,000,000; enter table with resulting northing.

Enter table using northing to nearest 100 meters and interpolate.

Log XV = Log of function XV (sign always +).

| Northing | Function XV | Diff. | Log XV  | Diff. | Northing | Function XV | Diff. | Log XV  | Diff. |
|----------|-------------|-------|---------|-------|----------|-------------|-------|---------|-------|
| 0        | 0           |       | 0       |       | 310,000  | 1585.0      | 51.2  | 3.20003 | 1426  |
| 1,000    | 5.109       | 5.109 | 0.70834 | 70834 | 320,000  | 1636.3      | 51.3  | 3.21386 | 1383  |
| 2,000    | 10.218      | 5.109 | 1.00937 | 30103 | 330,000  | 1687.5      | 51.2  | 3.22724 | 1338  |
| 3,000    | 15.327      | 5.109 | 1.18546 | 17609 | 340,000  | 1738.7      | 51.2  | 3.24022 | 1298  |
| 4,000    | 20.436      | 5.109 | 1.31040 | 12494 | 350,000  | 1789.9      | 51.2  | 3.25283 | 1261  |
|          |             |       |         |       |          |             |       |         |       |
| 5,000    | 25.545      | 5.109 | 1.40731 | 9691  | 360,000  | 1841.2      | 51.3  | 3.26510 | 1227  |
| 6,000    | 30.654      | 5.109 | 1.48649 | 7918  | 370,000  | 1892.4      | 51.2  | 3.27701 | 1191  |
| 7,000    | 35.763      | 5.109 | 1.55343 | 6694  | 380,000  | 1943.7      | 51.3  | 3.28863 | 1162  |
| 8,000    | 40.872      | 5.109 | 1.61143 | 5800  | 390,000  | 1995.0      | 51.3  | 3.29994 | 1131  |
| 9,000    | 45.981      | 5.109 | 1.66258 | 5115  | 400,000  | 2046.3      | 51.3  | 3.31097 | 1103  |
|          |             |       |         |       |          |             |       |         |       |
| 10,000   | 51.090      | 5.109 | 1.70834 | 4576  | 410,000  | 2097.6      | 51.3  | 3.32172 | 1075  |
| 20,000   | 102.18      | 51.09 | 2.00937 | 30103 | 420,000  | 2148.9      | 51.3  | 3.33222 | 1050  |
| 30,000   | 153.27      | 51.09 | 2.18546 | 17609 | 430,000  | 2200.2      | 51.3  | 3.34246 | 1024  |
| 40,000   | 204.36      | 51.09 | 2.31040 | 12494 | 440,000  | 2251.5      | 51.3  | 3.35247 | 1001  |
| 50,000   | 255.46      | 51.10 | 2.40732 | 9692  | 450,000  | 2302.9      | 51.4  | 3.36228 | 981   |
|          |             |       |         |       |          |             |       |         |       |
| 60,000   | 306.55      | 51.09 | 2.48650 | 7918  | 460,000  | 2354.2      | 51.3  | 3.37184 | 956   |
| 70,000   | 357.65      | 51.10 | 2.55346 | 6696  | 470,000  | 2405.6      | 51.4  | 3.38122 | 938   |
| 80,000   | 408.74      | 51.09 | 2.61145 | 5799  | 480,000  | 2456.9      | 51.3  | 3.39039 | 917   |
| 90,000   | 459.84      | 51.10 | 2.66261 | 5116  | 490,000  | 2508.3      | 51.4  | 3.39938 | 899   |
| 100,000  | 510.94      | 51.10 | 2.70837 | 4576  | 500,000  | 2559.7      | 51.4  | 3.40819 | 881   |
|          |             |       |         |       |          |             |       |         |       |
| 110,000  | 562.05      | 51.11 | 2.74978 | 4141  | 510,000  | 2611.1      | 51.4  | 3.41682 | 863   |
| 120,000  | 613.15      | 51.10 | 2.78757 | 3779  | 520,000  | 2662.6      | 51.5  | 3.42531 | 849   |
| 130,000  | 664.26      | 51.11 | 2.82234 | 3477  | 530,000  | 2714.0      | 51.4  | 3.43361 | 830   |
| 140,000  | 715.38      | 51.12 | 2.85454 | 3220  | 540,000  | 2765.4      | 51.4  | 3.44176 | 815   |
| 150,000  | 766.49      | 51.11 | 2.88451 | 2997  | 550,000  | 2816.9      | 51.5  | 3.44977 | 801   |
|          |             |       |         |       |          |             |       |         |       |
| 160,000  | 817.61      | 51.12 | 2.91255 | 2804  | 560,000  | 2868.4      | 51.5  | 3.45764 | 787   |
| 170,000  | 868.74      | 51.13 | 2.93889 | 2634  | 570,000  | 2919.9      | 51.5  | 3.46537 | 773   |
| 180,000  | 919.87      | 51.13 | 2.96373 | 2484  | 580,000  | 2971.4      | 51.5  | 3.47296 | 759   |
| 190,000  | 971.00      | 51.13 | 2.98722 | 2349  | 590,000  | 3022.9      | 51.5  | 3.48042 | 746   |
| 200,000  | 1022.1      | 51.1  | 3.00949 | 2227  | 600,000  | 3074.4      | 51.5  | 3.48776 | 734   |
|          |             |       |         |       |          |             |       |         |       |
| 210,000  | 1073.3      | 51.2  | 3.03072 | 2123  | 610,000  | 3126.0      | 51.6  | 3.49499 | 723   |
| 220,000  | 1124.4      | 51.1  | 3.05092 | 2020  | 620,000  | 3177.5      | 51.5  | 3.50209 | 710   |
| 230,000  | 1175.6      | 51.2  | 3.07026 | 1934  | 630,000  | 3229.1      | 51.6  | 3.50908 | 699   |
| 240,000  | 1226.7      | 51.1  | 3.08874 | 1848  | 640,000  | 3280.7      | 51.6  | 3.51597 | 689   |
| 250,000  | 1277.9      | 51.2  | 3.10650 | 1770  | 650,000  | 3332.3      | 51.6  | 3.52274 | 677   |
|          |             |       |         |       |          |             |       |         |       |
| 260,000  | 1329.1      | 51.2  | 3.12356 | 1706  | 660,000  | 3384.0      | 51.7  | 3.52943 | 669   |
| 270,000  | 1380.3      | 51.2  | 3.13997 | 1641  | 670,000  | 3435.6      | 51.6  | 3.53600 | 657   |
| 280,000  | 1431.4      | 51.1  | 3.15576 | 1579  | 680,000  | 3487.3      | 51.7  | 3.54249 | 649   |
| 290,000  | 1482.6      | 51.2  | 3.17102 | 1526  | 690,000  | 3539.0      | 51.7  | 3.54888 | 639   |
| 300,000  | 1533.8      | 51.2  | 3.18577 | 1475  | 700,000  | 3590.7      | 51.7  | 3.55518 | 630   |

Table 6. Convergence—Continued

| Northing  | Function XV | Diff. | Log XV  | Diff. | Northing  | Function XV | Diff. | Log XV  | Diff. |
|-----------|-------------|-------|---------|-------|-----------|-------------|-------|---------|-------|
| 700,000   | 3500.7      | 51.7  | 3.55518 | 630   |           |             |       |         |       |
| 710,000   | 3642.4      | 51.7  | 3.56139 | 621   | 1,160,000 | 5092.3      | 52.8  | 3.77750 | 384   |
| 720,000   | 3694.1      | 51.7  | 3.56751 | 612   | 1,170,000 | 6045.1      | 52.8  | 3.78140 | 381   |
| 730,000   | 3745.9      | 51.8  | 3.57356 | 605   | 1,180,000 | 6098.0      | 52.9  | 3.78519 | 379   |
| 740,000   | 3797.6      | 51.7  | 3.57951 | 595   | 1,190,000 | 6150.9      | 52.9  | 3.78894 | 375   |
| 750,000   | 3849.4      | 51.8  | 3.58530 | 588   | 1,200,000 | 6203.8      | 52.9  | 3.79266 | 372   |
| 760,000   | 3901.2      | 51.8  | 3.59120 | 581   | 1,210,000 | 6256.7      | 52.9  | 3.79635 | 369   |
| 770,000   | 3953.1      | 51.9  | 3.59694 | 574   | 1,220,000 | 6309.7      | 53.0  | 3.80001 | 366   |
| 780,000   | 4004.9      | 51.8  | 3.60259 | 565   | 1,230,000 | 6362.7      | 53.0  | 3.80364 | 363   |
| 790,000   | 4056.8      | 51.9  | 3.60818 | 559   | 1,240,000 | 6415.8      | 53.1  | 3.80725 | 361   |
| 800,000   | 4108.7      | 51.9  | 3.61370 | 552   | 1,250,000 | 6468.8      | 53.0  | 3.81082 | 357   |
| 810,000   | 4160.6      | 51.9  | 3.61916 | 546   | 1,260,000 | 6521.9      | 53.1  | 3.81437 | 355   |
| 820,000   | 4212.5      | 51.9  | 3.62454 | 538   | 1,270,000 | 6575.1      | 53.2  | 3.81790 | 353   |
| 830,000   | 4264.4      | 51.9  | 3.62986 | 532   | 1,280,000 | 6628.3      | 53.2  | 3.82140 | 350   |
| 840,000   | 4316.4      | 52.0  | 3.63512 | 526   | 1,290,000 | 6681.5      | 53.2  | 3.82487 | 347   |
| 850,000   | 4368.4      | 52.0  | 3.64032 | 520   | 1,300,000 | 6734.7      | 53.2  | 3.82832 | 345   |
| 860,000   | 4420.4      | 52.0  | 3.64546 | 514   | 1,310,000 | 6788.0      | 53.3  | 3.83174 | 342   |
| 870,000   | 4472.5      | 52.1  | 3.65055 | 509   | 1,320,000 | 6841.3      | 53.3  | 3.83514 | 340   |
| 880,000   | 4524.5      | 52.0  | 3.65557 | 502   | 1,330,000 | 6894.7      | 53.4  | 3.83852 | 338   |
| 890,000   | 4576.6      | 52.1  | 3.66054 | 497   | 1,340,000 | 6948.0      | 53.3  | 3.84186 | 334   |
| 900,000   | 4628.7      | 52.1  | 3.66546 | 492   | 1,350,000 | 7001.5      | 53.5  | 3.84519 | 333   |
| 910,000   | 4680.8      | 52.1  | 3.67032 | 486   | 1,360,000 | 7054.9      | 53.4  | 3.84849 | 330   |
| 920,000   | 4733.0      | 52.2  | 3.67514 | 482   | 1,370,000 | 7108.4      | 53.5  | 3.85177 | 328   |
| 930,000   | 4785.2      | 52.2  | 3.67990 | 476   | 1,380,000 | 7161.9      | 53.5  | 3.85503 | 326   |
| 940,000   | 4837.3      | 52.1  | 3.68460 | 470   | 1,390,000 | 7215.5      | 53.6  | 3.85827 | 324   |
| 950,000   | 4889.6      | 52.3  | 3.68927 | 467   | 1,400,000 | 7269.1      | 53.6  | 3.86148 | 321   |
| 960,000   | 4941.8      | 52.2  | 3.69389 | 462   | 1,410,000 | 7322.7      | 53.6  | 3.86467 | 319   |
| 970,000   | 4994.1      | 52.3  | 3.69846 | 457   | 1,420,000 | 7376.4      | 53.7  | 3.86784 | 317   |
| 980,000   | 5046.4      | 52.3  | 3.70298 | 452   | 1,430,000 | 7430.1      | 53.7  | 3.87099 | 315   |
| 990,000   | 5098.7      | 52.3  | 3.70746 | 448   | 1,440,000 | 7483.9      | 53.8  | 3.87413 | 314   |
| 1,000,000 | 5151.1      | 52.4  | 3.71190 | 444   | 1,450,000 | 7537.7      | 53.8  | 3.87724 | 311   |
| 1,010,000 | 5203.4      | 52.3  | 3.71629 | 439   | 1,460,000 | 7591.5      | 53.8  | 3.88033 | 309   |
| 1,020,000 | 5255.8      | 52.4  | 3.72064 | 435   | 1,470,000 | 7645.4      | 53.9  | 3.88340 | 307   |
| 1,030,000 | 5308.2      | 52.4  | 3.72495 | 431   | 1,480,000 | 7699.3      | 53.9  | 3.88645 | 305   |
| 1,040,000 | 5360.7      | 52.5  | 3.72922 | 427   | 1,490,000 | 7753.2      | 53.9  | 3.88948 | 303   |
| 1,050,000 | 5413.2      | 52.5  | 3.73345 | 423   | 1,500,000 | 7807.2      | 54.0  | 3.89250 | 302   |
| 1,060,000 | 5465.7      | 52.5  | 3.73765 | 420   | 1,510,000 | 7861.2      | 54.0  | 3.89549 | 299   |
| 1,070,000 | 5518.2      | 52.5  | 3.74180 | 415   | 1,520,000 | 7915.3      | 54.1  | 3.89847 | 298   |
| 1,080,000 | 5570.8      | 52.6  | 3.74592 | 412   | 1,530,000 | 7969.4      | 54.1  | 3.90143 | 296   |
| 1,090,000 | 5623.4      | 52.6  | 3.75000 | 408   | 1,540,000 | 8023.6      | 54.2  | 3.90437 | 294   |
| 1,100,000 | 5676.0      | 52.6  | 3.75404 | 404   | 1,550,000 | 8077.8      | 54.2  | 3.90729 | 292   |
| 1,110,000 | 5728.6      | 52.6  | 3.75805 | 401   | 1,560,000 | 8132.0      | 54.2  | 3.91020 | 291   |
| 1,120,000 | 5781.3      | 52.7  | 3.76203 | 398   | 1,570,000 | 8186.3      | 54.3  | 3.91309 | 289   |
| 1,130,000 | 5834.0      | 52.7  | 3.76597 | 394   | 1,580,000 | 8240.6      | 54.3  | 3.91596 | 287   |
| 1,140,000 | 5886.7      | 52.7  | 3.76987 | 390   | 1,590,000 | 8294.9      | 54.3  | 3.91881 | 285   |
| 1,150,000 | 5939.5      | 52.8  | 3.77375 | 388   | 1,600,000 | 8349.3      | 54.4  | 3.92165 | 284   |

Table 6. Convergence—Continued

| Nothing   | Function XV | Diff. | Log XV  | Diff. | Nothing   | Function XV | Diff. | Log XV  | Diff. |
|-----------|-------------|-------|---------|-------|-----------|-------------|-------|---------|-------|
| 1,000,000 | 8349.3      | 54.4  | 3.92165 | 284   |           |             |       |         |       |
| 1,610,000 | 8403.8      | 54.5  | 3.92448 | 283   | 2,000,000 | 10904       | 56    | 4.03750 | 224   |
| 1,620,000 | 8458.3      | 54.5  | 3.92728 | 280   | 2,070,000 | 10961       | 57    | 4.03985 | 226   |
| 1,630,000 | 8512.8      | 54.5  | 3.93007 | 279   | 2,080,000 | 11018       | 57    | 4.04210 | 225   |
| 1,640,000 | 8567.4      | 54.6  | 3.93285 | 278   | 2,090,000 | 11075       | 57    | 4.04434 | 224   |
| 1,650,000 | 8622.0      | 54.6  | 3.93561 | 276   | 2,100,000 | 11132       | 57    | 4.04657 | 223   |
| 1,660,000 | 8676.7      | 54.7  | 3.93835 | 274   | 2,110,000 | 11189       | 57    | 4.04879 | 222   |
| 1,670,000 | 8731.4      | 54.7  | 3.94108 | 273   | 2,120,000 | 11246       | 57    | 4.05100 | 221   |
| 1,680,000 | 8786.2      | 54.8  | 3.94380 | 272   | 2,130,000 | 11303       | 57    | 4.05319 | 219   |
| 1,690,000 | 8841.0      | 54.8  | 3.94650 | 270   | 2,140,000 | 11361       | 58    | 4.05542 | 223   |
| 1,700,000 | 8895.9      | 54.9  | 3.94919 | 269   | 2,150,000 | 11418       | 57    | 4.05759 | 217   |
| 1,710,000 | 8950.8      | 54.9  | 3.95186 | 267   | 2,160,000 | 11475       | 57    | 4.05975 | 216   |
| 1,720,000 | 9005.7      | 54.9  | 3.95452 | 266   | 2,170,000 | 11533       | 58    | 4.06194 | 219   |
| 1,730,000 | 9060.7      | 55.0  | 3.95716 | 264   | 2,180,000 | 11590       | 57    | 4.06408 | 214   |
| 1,740,000 | 9115.7      | 55.0  | 3.95979 | 263   | 2,190,000 | 11648       | 58    | 4.06625 | 217   |
| 1,750,000 | 9170.8      | 55.1  | 3.96241 | 262   | 2,200,000 | 11705       | 57    | 4.06837 | 212   |
| 1,760,000 | 9226.0      | 55.2  | 3.96501 | 260   | 2,210,000 | 11763       | 58    | 4.07052 | 215   |
| 1,770,000 | 9281.2      | 55.2  | 3.96760 | 259   | 2,220,000 | 11821       | 58    | 4.07265 | 213   |
| 1,780,000 | 9336.4      | 55.2  | 3.97018 | 258   | 2,230,000 | 11879       | 58    | 4.07478 | 213   |
| 1,790,000 | 9391.7      | 55.3  | 3.97274 | 256   | 2,240,000 | 11937       | 58    | 4.07690 | 212   |
| 1,800,000 | 9447.0      | 55.3  | 3.97529 | 255   | 2,250,000 | 11995       | 58    | 4.07900 | 210   |
| 1,810,000 | 9502.4      | 55.4  | 3.97783 | 254   | 2,260,000 | 12053       | 58    | 4.08110 | 210   |
| 1,820,000 | 9557.9      | 55.5  | 3.98030 | 253   | 2,270,000 | 12111       | 58    | 4.08318 | 208   |
| 1,830,000 | 9613.4      | 55.5  | 3.98288 | 252   | 2,280,000 | 12169       | 58    | 4.08525 | 207   |
| 1,840,000 | 9668.9      | 55.5  | 3.98538 | 250   | 2,290,000 | 12227       | 58    | 4.08732 | 207   |
| 1,850,000 | 9724.5      | 55.6  | 3.98787 | 249   | 2,300,000 | 12285       | 58    | 4.08938 | 206   |
| 1,860,000 | 9780.1      | 55.6  | 3.99034 | 247   | 2,310,000 | 12344       | 59    | 4.09146 | 208   |
| 1,870,000 | 9835.8      | 55.7  | 3.99281 | 247   | 2,320,000 | 12402       | 58    | 4.09349 | 203   |
| 1,880,000 | 9891.6      | 55.8  | 3.99527 | 246   | 2,330,000 | 12461       | 59    | 4.09555 | 206   |
| 1,890,000 | 9947.4      | 55.8  | 3.99771 | 244   | 2,340,000 | 12519       | 58    | 4.09757 | 202   |
| 1,900,000 | 10008       | 55.6  | 4.00013 | 242   | 2,350,000 | 12578       | 59    | 4.09961 | 204   |
| 1,910,000 | 10059       | 56    | 4.00255 | 242   | 2,360,000 | 12636       | 58    | 4.10161 | 200   |
| 1,920,000 | 10115       | 56    | 4.00497 | 242   | 2,370,000 | 12695       | 59    | 4.10363 | 202   |
| 1,930,000 | 10171       | 56    | 4.00736 | 239   | 2,380,000 | 12754       | 59    | 4.10565 | 202   |
| 1,940,000 | 10227       | 56    | 4.00975 | 239   | 2,390,000 | 12813       | 59    | 4.10765 | 200   |
| 1,950,000 | 10283       | 56    | 4.01212 | 237   | 2,400,000 | 12872       | 59    | 4.10965 | 200   |
| 1,960,000 | 10339       | 56    | 4.01448 | 236   | 2,410,000 | 12931       | 59    | 4.11163 | 198   |
| 1,970,000 | 10396       | 57    | 4.01687 | 239   | 2,420,000 | 12990       | 59    | 4.11361 | 198   |
| 1,980,000 | 10452       | 56    | 4.01920 | 233   | 2,430,000 | 13049       | 59    | 4.11558 | 197   |
| 1,990,000 | 10508       | 56    | 4.02152 | 232   | 2,440,000 | 13109       | 60    | 4.11757 | 199   |
| 2,000,000 | 10565       | 57    | 4.02387 | 235   | 2,450,000 | 13168       | 59    | 4.11952 | 195   |
| 2,010,000 | 10621       | 56    | 4.02617 | 230   | 2,460,000 | 13228       | 60    | 4.12149 | 197   |
| 2,020,000 | 10678       | 57    | 4.02849 | 232   | 2,470,000 | 13287       | 59    | 4.12343 | 194   |
| 2,030,000 | 10734       | 56    | 4.03076 | 227   | 2,480,000 | 13347       | 60    | 4.12538 | 195   |
| 2,040,000 | 10791       | 57    | 4.03306 | 230   | 2,490,000 | 13406       | 59    | 4.12730 | 192   |
| 2,050,000 | 10848       | 57    | 4.03535 | 229   | 2,500,000 | 13466       | 60    | 4.12924 | 194   |

Table 6. Convergence—Continued

| Northing  | Function XV | Diff. | Log XV  | Diff. | Northing  | Function XV | Diff. | Log XV  | Diff. |
|-----------|-------------|-------|---------|-------|-----------|-------------|-------|---------|-------|
| 2,500,000 | 13466       | 60    | 4.12924 | 194   |           |             |       |         |       |
| 2,510,000 | 13526       | 60    | 4.13117 | 193   | 2,960,000 | 16305       | 63    | 4.21232 | 168   |
| 2,520,000 | 13586       | 60    | 4.13309 | 192   | 2,970,000 | 16369       | 64    | 4.21402 | 170   |
| 2,530,000 | 13646       | 60    | 4.13501 | 192   | 2,980,000 | 16433       | 64    | 4.21572 | 170   |
| 2,540,000 | 13706       | 60    | 4.13691 | 190   | 2,990,000 | 16497       | 64    | 4.21740 | 168   |
| 2,550,000 | 13766       | 60    | 4.13881 | 190   | 3,000,000 | 16561       | 64    | 4.21909 | 169   |
|           |             |       |         |       |           |             |       |         |       |
| 2,560,000 | 13826       | 60    | 4.14070 | 189   | 3,010,000 | 16626       | 65    | 4.22079 | 170   |
| 2,570,000 | 13886       | 60    | 4.14258 | 188   | 3,020,000 | 16690       | 64    | 4.22246 | 167   |
| 2,580,000 | 13947       | 61    | 4.14448 | 190   | 3,030,000 | 16755       | 65    | 4.22414 | 168   |
| 2,590,000 | 14007       | 60    | 4.14635 | 187   | 3,040,000 | 16819       | 64    | 4.22580 | 166   |
| 2,600,000 | 14068       | 61    | 4.14823 | 188   | 3,050,000 | 16884       | 65    | 4.22748 | 168   |
|           |             |       |         |       |           |             |       |         |       |
| 2,610,000 | 14128       | 60    | 4.15008 | 185   | 3,060,000 | 16949       | 65    | 4.22914 | 166   |
| 2,620,000 | 14189       | 61    | 4.15195 | 187   | 3,070,000 | 17014       | 65    | 4.23081 | 167   |
| 2,630,000 | 14250       | 61    | 4.15381 | 186   | 3,080,000 | 17079       | 65    | 4.23246 | 165   |
| 2,640,000 | 14311       | 61    | 4.15567 | 186   | 3,090,000 | 17144       | 65    | 4.23411 | 165   |
| 2,650,000 | 14372       | 61    | 4.15752 | 185   | 3,100,000 | 17209       | 65    | 4.23576 | 165   |
|           |             |       |         |       |           |             |       |         |       |
| 2,660,000 | 14433       | 61    | 4.15936 | 184   | 3,110,000 | 17274       | 65    | 4.23739 | 163   |
| 2,670,000 | 14494       | 61    | 4.16119 | 183   | 3,120,000 | 17340       | 66    | 4.23905 | 166   |
| 2,680,000 | 14555       | 61    | 4.16301 | 182   | 3,130,000 | 17406       | 66    | 4.24070 | 165   |
| 2,690,000 | 14616       | 61    | 4.16483 | 182   | 3,140,000 | 17471       | 65    | 4.24232 | 162   |
| 2,700,000 | 14678       | 62    | 4.16667 | 184   | 3,150,000 | 17537       | 66    | 4.24396 | 164   |
|           |             |       |         |       |           |             |       |         |       |
| 2,710,000 | 14739       | 61    | 4.16847 | 180   | 3,160,000 | 17603       | 66    | 4.24559 | 163   |
| 2,720,000 | 14801       | 62    | 4.17029 | 182   | 3,170,000 | 17669       | 66    | 4.24721 | 162   |
| 2,730,000 | 14862       | 61    | 4.17208 | 179   | 3,180,000 | 17735       | 66    | 4.24883 | 162   |
| 2,740,000 | 14924       | 62    | 4.17389 | 181   | 3,190,000 | 17801       | 66    | 4.25044 | 161   |
| 2,750,000 | 14986       | 62    | 4.17569 | 180   | 3,200,000 | 17868       | 67    | 4.25208 | 164   |
|           |             |       |         |       |           |             |       |         |       |
| 2,760,000 | 15048       | 62    | 4.17748 | 179   | 3,210,000 | 17934       | 66    | 4.25368 | 160   |
| 2,770,000 | 15110       | 62    | 4.17926 | 178   | 3,220,000 | 18001       | 67    | 4.25530 | 162   |
| 2,780,000 | 15172       | 62    | 4.18104 | 178   | 3,230,000 | 18067       | 66    | 4.25689 | 159   |
| 2,790,000 | 15234       | 62    | 4.18281 | 177   | 3,240,000 | 18134       | 67    | 4.25849 | 160   |
| 2,800,000 | 15296       | 62    | 4.18458 | 177   | 3,250,000 | 18201       | 67    | 4.26010 | 161   |
|           |             |       |         |       |           |             |       |         |       |
| 2,810,000 | 15359       | 63    | 4.18636 | 178   | 3,260,000 | 18268       | 67    | 4.26169 | 159   |
| 2,820,000 | 15421       | 62    | 4.18811 | 175   | 3,270,000 | 18335       | 67    | 4.26328 | 159   |
| 2,830,000 | 15484       | 63    | 4.18988 | 177   | 3,280,000 | 18403       | 68    | 4.26489 | 161   |
| 2,840,000 | 15546       | 62    | 4.19162 | 174   | 3,290,000 | 18470       | 67    | 4.26647 | 158   |
| 2,850,000 | 15609       | 63    | 4.19338 | 176   | 3,300,000 | 18538       | 68    | 4.26806 | 159   |
|           |             |       |         |       |           |             |       |         |       |
| 2,860,000 | 15672       | 63    | 4.19512 | 174   | 3,310,000 | 18605       | 67    | 4.26963 | 157   |
| 2,870,000 | 15735       | 63    | 4.19687 | 175   | 3,320,000 | 18673       | 68    | 4.27121 | 158   |
| 2,880,000 | 15798       | 63    | 4.19860 | 173   | 3,330,000 | 18741       | 68    | 4.27279 | 158   |
| 2,890,000 | 15861       | 63    | 4.20033 | 173   | 3,340,000 | 18809       | 68    | 4.27437 | 158   |
| 2,900,000 | 15924       | 63    | 4.20205 | 172   | 3,350,000 | 18877       | 68    | 4.27593 | 156   |
|           |             |       |         |       |           |             |       |         |       |
| 2,910,000 | 15987       | 63    | 4.20377 | 172   | 3,360,000 | 18945       | 68    | 4.27749 | 156   |
| 2,920,000 | 16051       | 64    | 4.20550 | 173   | 3,370,000 | 19014       | 69    | 4.27907 | 158   |
| 2,930,000 | 16114       | 63    | 4.20720 | 170   | 3,380,000 | 19082       | 68    | 4.28062 | 155   |
| 2,940,000 | 16178       | 64    | 4.20892 | 172   | 3,390,000 | 19151       | 69    | 4.28219 | 157   |
| 2,950,000 | 16242       | 64    | 4.21064 | 172   | 3,400,000 | 19219       | 68    | 4.28373 | 154   |

Table 6. Convergence—Continued

| Northing  | Function XV | Diff. | Log XV  | Diff. | Northing  | Function XV | Diff. | Log XV  | Diff. |
|-----------|-------------|-------|---------|-------|-----------|-------------|-------|---------|-------|
| 3,400,000 | 19219       | 68    | 4.28373 | 154   |           |             |       |         |       |
| 3,410,000 | 19288       | 69    | 4.28529 | 156   | 3,860,000 | 22532       | 75    | 4.35280 | 145   |
| 3,420,000 | 19357       | 69    | 4.28684 | 155   | 3,870,000 | 22608       | 76    | 4.35426 | 146   |
| 3,430,000 | 19427       | 70    | 4.28841 | 157   | 3,880,000 | 22683       | 75    | 4.35570 | 144   |
| 3,440,000 | 19496       | 69    | 4.28995 | 154   | 3,890,000 | 22759       | 76    | 4.35715 | 145   |
| 3,450,000 | 19565       | 69    | 4.29148 | 153   | 3,900,000 | 22835       | 76    | 4.35860 | 145   |
| 3,460,000 | 19635       | 70    | 4.29303 | 155   | 3,910,000 | 22911       | 76    | 4.36004 | 144   |
| 3,470,000 | 19704       | 69    | 4.29455 | 152   | 3,920,000 | 22988       | 77    | 4.36150 | 146   |
| 3,480,000 | 19774       | 70    | 4.29609 | 154   | 3,930,000 | 23064       | 76    | 4.36293 | 143   |
| 3,490,000 | 19844       | 70    | 4.29763 | 154   | 3,940,000 | 23141       | 77    | 4.36438 | 145   |
| 3,500,000 | 19914       | 70    | 4.29916 | 153   | 3,950,000 | 23218       | 77    | 4.36582 | 144   |
| 3,510,000 | 19984       | 70    | 4.30068 | 152   | 3,960,000 | 23295       | 77    | 4.36726 | 144   |
| 3,520,000 | 20055       | 71    | 4.30222 | 154   | 3,970,000 | 23372       | 77    | 4.36870 | 144   |
| 3,530,000 | 20125       | 70    | 4.30374 | 152   | 3,980,000 | 23450       | 78    | 4.37014 | 144   |
| 3,540,000 | 20196       | 71    | 4.30527 | 153   | 3,990,000 | 23527       | 77    | 4.37157 | 143   |
| 3,550,000 | 20267       | 71    | 4.30679 | 152   | 4,000,000 | 23605       | 78    | 4.37300 | 143   |
| 3,560,000 | 20337       | 70    | 4.30829 | 150   | 4,010,000 | 23683       | 78    | 4.37444 | 144   |
| 3,570,000 | 20408       | 71    | 4.30980 | 151   | 4,020,000 | 23761       | 78    | 4.37586 | 142   |
| 3,580,000 | 20480       | 72    | 4.31133 | 153   | 4,030,000 | 23840       | 79    | 4.37731 | 145   |
| 3,590,000 | 20551       | 71    | 4.31283 | 150   | 4,040,000 | 23918       | 78    | 4.37872 | 141   |
| 3,600,000 | 20622       | 71    | 4.31433 | 150   | 4,050,000 | 23997       | 79    | 4.38016 | 144   |
| 3,610,000 | 20694       | 72    | 4.31584 | 151   | 4,060,000 | 24076       | 79    | 4.38158 | 142   |
| 3,620,000 | 20766       | 72    | 4.31735 | 151   | 4,070,000 | 24155       | 79    | 4.38301 | 143   |
| 3,630,000 | 20837       | 71    | 4.31884 | 149   | 4,080,000 | 24234       | 79    | 4.38443 | 142   |
| 3,640,000 | 20909       | 72    | 4.32033 | 149   | 4,090,000 | 24313       | 79    | 4.38584 | 141   |
| 3,650,000 | 20982       | 73    | 4.32185 | 152   | 4,100,000 | 24393       | 80    | 4.38727 | 143   |
| 3,660,000 | 21054       | 72    | 4.32333 | 148   | 4,110,000 | 24473       | 80    | 4.38869 | 142   |
| 3,670,000 | 21126       | 72    | 4.32482 | 149   | 4,120,000 | 24553       | 80    | 4.39010 | 141   |
| 3,680,000 | 21199       | 73    | 4.32632 | 150   | 4,130,000 | 24633       | 80    | 4.39152 | 142   |
| 3,690,000 | 21272       | 73    | 4.32781 | 149   | 4,140,000 | 24713       | 80    | 4.39293 | 141   |
| 3,700,000 | 21345       | 73    | 4.32930 | 149   | 4,150,000 | 24794       | 81    | 4.39435 | 142   |
| 3,710,000 | 21418       | 73    | 4.33078 | 148   | 4,160,000 | 24874       | 80    | 4.39575 | 140   |
| 3,720,000 | 21491       | 73    | 4.33226 | 148   | 4,170,000 | 24955       | 81    | 4.39716 | 141   |
| 3,730,000 | 21564       | 73    | 4.33373 | 147   | 4,180,000 | 25036       | 81    | 4.39856 | 140   |
| 3,740,000 | 21638       | 74    | 4.33522 | 140   | 4,190,000 | 25118       | 82    | 4.39999 | 143   |
| 3,750,000 | 21711       | 73    | 4.33668 | 146   | 4,200,000 | 25199       | 81    | 4.40138 | 139   |
| 3,760,000 | 21785       | 74    | 4.33816 | 148   | 4,210,000 | 25281       | 82    | 4.40279 | 141   |
| 3,770,000 | 21859       | 74    | 4.33963 | 147   | 4,220,000 | 25363       | 82    | 4.40420 | 141   |
| 3,780,000 | 21933       | 74    | 4.34110 | 147   | 4,230,000 | 25445       | 82    | 4.40560 | 140   |
| 3,790,000 | 22008       | 75    | 4.34258 | 148   | 4,240,000 | 25527       | 82    | 4.40700 | 140   |
| 3,800,000 | 22082       | 74    | 4.34404 | 146   | 4,250,000 | 25610       | 83    | 4.40841 | 141   |
| 3,810,000 | 22157       | 75    | 4.34551 | 147   | 4,260,000 | 25692       | 82    | 4.40980 | 139   |
| 3,820,000 | 22231       | 74    | 4.34696 | 145   | 4,270,000 | 25775       | 83    | 4.41120 | 140   |
| 3,830,000 | 22306       | 75    | 4.34842 | 146   | 4,280,000 | 25859       | 84    | 4.41261 | 141   |
| 3,840,000 | 22381       | 75    | 4.34988 | 146   | 4,290,000 | 25942       | 83    | 4.41400 | 139   |
| 3,850,000 | 22457       | 76    | 4.35135 | 147   | 4,300,000 | 26025       | 83    | 4.41539 | 139   |

Table 6. Convergence—Continued

| Northing  | Function XV | Diff. | Log XV  | Diff. | Northing  | Function XV | Diff. | Log XV  | Diff. |
|-----------|-------------|-------|---------|-------|-----------|-------------|-------|---------|-------|
| 4,300,000 | 26025       | 83    | 4.41539 | 139   |           |             |       |         |       |
| 4,310,000 | 26109       | 84    | 4.41079 | 140   | 4,700,000 | 30117       | 94    | 4.47881 | 136   |
| 4,320,000 | 26193       | 84    | 4.41819 | 140   | 4,770,000 | 30212       | 95    | 4.48018 | 137   |
| 4,330,000 | 26277       | 84    | 4.41958 | 139   | 4,780,000 | 30307       | 95    | 4.48184 | 136   |
| 4,340,000 | 26362       | 85    | 4.42098 | 140   | 4,790,000 | 30403       | 96    | 4.48302 | 138   |
| 4,350,000 | 26446       | 84    | 4.42236 | 138   | 4,800,000 | 30498       | 95    | 4.48427 | 135   |
|           |             |       |         |       |           |             |       |         |       |
| 4,360,000 | 26531       | 85    | 4.42375 | 139   | 4,810,000 | 30594       | 96    | 4.48564 | 137   |
| 4,370,000 | 26616       | 85    | 4.42514 | 139   | 4,820,000 | 30691       | 97    | 4.48701 | 137   |
| 4,380,000 | 26702       | 86    | 4.42654 | 140   | 4,830,000 | 30787       | 96    | 4.48837 | 136   |
| 4,390,000 | 26787       | 85    | 4.42792 | 138   | 4,840,000 | 30884       | 97    | 4.48973 | 136   |
| 4,400,000 | 26873       | 86    | 4.42932 | 140   | 4,850,000 | 30981       | 97    | 4.49110 | 137   |
|           |             |       |         |       |           |             |       |         |       |
| 4,410,000 | 26959       | 86    | 4.43070 | 138   | 4,860,000 | 31079       | 98    | 4.49247 | 137   |
| 4,420,000 | 27045       | 86    | 4.43209 | 139   | 4,870,000 | 31177       | 98    | 4.49383 | 136   |
| 4,430,000 | 27131       | 86    | 4.43347 | 138   | 4,880,000 | 31275       | 98    | 4.49520 | 137   |
| 4,440,000 | 27218       | 87    | 4.43486 | 139   | 4,890,000 | 31373       | 98    | 4.49656 | 136   |
| 4,450,000 | 27305       | 87    | 4.43624 | 138   | 4,900,000 | 31472       | 99    | 4.49792 | 136   |
|           |             |       |         |       |           |             |       |         |       |
| 4,460,000 | 27392       | 87    | 4.43762 | 138   | 4,910,000 | 31570       | 98    | 4.49927 | 135   |
| 4,470,000 | 27479       | 87    | 4.43900 | 138   | 4,920,000 | 31670       | 100   | 4.50065 | 138   |
| 4,480,000 | 27567       | 88    | 4.44039 | 139   | 4,930,000 | 31769       | 99    | 4.50200 | 135   |
| 4,490,000 | 27654       | 87    | 4.44176 | 137   | 4,940,000 | 31869       | 100   | 4.50337 | 137   |
| 4,500,000 | 27742       | 88    | 4.44314 | 138   | 4,950,000 | 31969       | 100   | 4.50473 | 136   |
|           |             |       |         |       |           |             |       |         |       |
| 4,510,000 | 27831       | 89    | 4.44453 | 139   | 4,960,000 | 32070       | 101   | 4.50610 | 137   |
| 4,520,000 | 27919       | 88    | 4.44590 | 137   | 4,970,000 | 32170       | 100   | 4.50745 | 135   |
| 4,530,000 | 28008       | 89    | 4.44728 | 138   | 4,980,000 | 32272       | 102   | 4.50883 | 138   |
| 4,540,000 | 28097       | 89    | 4.44866 | 138   | 4,990,000 | 32373       | 101   | 4.51018 | 135   |
| 4,550,000 | 28186       | 89    | 4.45003 | 137   | 5,000,000 | 32475       | 102   | 4.51155 | 137   |
|           |             |       |         |       |           |             |       |         |       |
| 4,560,000 | 28275       | 89    | 4.45140 | 137   | 5,010,000 | 32577       | 102   | 4.51291 | 136   |
| 4,570,000 | 28365       | 90    | 4.45278 | 138   | 5,020,000 | 32679       | 102   | 4.51427 | 136   |
| 4,580,000 | 28455       | 90    | 4.45416 | 138   | 5,030,000 | 32782       | 103   | 4.51564 | 137   |
| 4,590,000 | 28545       | 90    | 4.45553 | 137   | 5,040,000 | 32885       | 103   | 4.51700 | 136   |
| 4,600,000 | 28635       | 90    | 4.45690 | 137   | 5,050,000 | 32988       | 103   | 4.51836 | 136   |
|           |             |       |         |       |           |             |       |         |       |
| 4,610,000 | 28726       | 91    | 4.45828 | 138   | 5,060,000 | 33092       | 104   | 4.51972 | 136   |
| 4,620,000 | 28817       | 91    | 4.45965 | 137   | 5,070,000 | 33196       | 104   | 4.52109 | 137   |
| 4,630,000 | 28908       | 91    | 4.46102 | 137   | 5,080,000 | 33300       | 104   | 4.52244 | 135   |
| 4,640,000 | 29000       | 92    | 4.46240 | 138   | 5,090,000 | 33405       | 105   | 4.52381 | 137   |
| 4,650,000 | 29091       | 91    | 4.46376 | 136   | 5,100,000 | 33510       | 105   | 4.52517 | 136   |
|           |             |       |         |       |           |             |       |         |       |
| 4,660,000 | 29183       | 92    | 4.46513 | 137   | 5,110,000 | 33615       | 105   | 4.52653 | 136   |
| 4,670,000 | 29276       | 93    | 4.46651 | 138   | 5,120,000 | 33721       | 106   | 4.52790 | 137   |
| 4,680,000 | 29368       | 92    | 4.46787 | 136   | 5,130,000 | 33827       | 106   | 4.52926 | 136   |
| 4,690,000 | 29461       | 93    | 4.46925 | 138   | 5,140,000 | 33933       | 106   | 4.53062 | 136   |
| 4,700,000 | 29554       | 93    | 4.47062 | 137   | 5,150,000 | 34040       | 107   | 4.53199 | 137   |
|           |             |       |         |       |           |             |       |         |       |
| 4,710,000 | 29647       | 93    | 4.47198 | 136   | 5,160,000 | 34147       | 107   | 4.53335 | 136   |
| 4,720,000 | 29740       | 93    | 4.47334 | 136   | 5,170,000 | 34255       | 107   | 4.53471 | 136   |
| 4,730,000 | 29834       | 94    | 4.47471 | 137   | 5,180,000 | 34362       | 108   | 4.53608 | 137   |
| 4,740,000 | 29928       | 94    | 4.47608 | 137   | 5,190,000 | 34470       | 108   | 4.53744 | 136   |
| 4,750,000 | 30023       | 95    | 4.47745 | 137   | 5,200,000 | 34579       | 109   | 4.53881 | 137   |

Table 8. Convergence—Continued

| Northing  | Function XV | Diff. | Log XV  | Diff. | Northing  | Function XV | Diff. | Log XV  | Diff. |
|-----------|-------------|-------|---------|-------|-----------|-------------|-------|---------|-------|
| 5,200,000 | 34579       | 109   | 4.53881 | 137   |           |             |       |         |       |
| 5,210,000 | 34688       | 100   | 4.54018 | 137   | 5,660,000 | 40006       | 128   | 4.60213 | 140   |
| 5,220,000 | 34797       | 109   | 4.54154 | 136   | 5,670,000 | 40134       | 128   | 4.60351 | 138   |
| 5,230,000 | 34907       | 110   | 4.54291 | 137   | 5,680,000 | 40263       | 129   | 4.60491 | 140   |
| 5,240,000 | 35017       | 110   | 4.54428 | 137   | 5,690,000 | 40393       | 130   | 4.60631 | 140   |
| 5,250,000 | 35127       | 110   | 4.54564 | 136   | 5,700,000 | 40523       | 130   | 4.60770 | 139   |
| 5,260,000 | 35238       | 111   | 4.54701 | 137   | 5,710,000 | 40653       | 130   | 4.60909 | 139   |
| 5,270,000 | 35349       | 111   | 4.54838 | 137   | 5,720,000 | 40781       | 131   | 4.61049 | 140   |
| 5,280,000 | 35460       | 111   | 4.54974 | 136   | 5,730,000 | 40916       | 132   | 4.61189 | 140   |
| 5,290,000 | 35572       | 112   | 4.55111 | 137   | 5,740,000 | 41048       | 132   | 4.61329 | 140   |
| 5,300,000 | 35684       | 112   | 4.55247 | 136   | 5,750,000 | 41181       | 133   | 4.61470 | 141   |
| 5,310,000 | 35797       | 113   | 4.55385 | 138   | 5,760,000 | 41314       | 133   | 4.61610 | 140   |
| 5,320,000 | 35910       | 113   | 4.55522 | 137   | 5,770,000 | 41447       | 133   | 4.61749 | 139   |
| 5,330,000 | 36023       | 113   | 4.55658 | 136   | 5,780,000 | 41582       | 135   | 4.61891 | 142   |
| 5,340,000 | 36137       | 114   | 4.55795 | 137   | 5,790,000 | 41716       | 134   | 4.61930 | 139   |
| 5,350,000 | 36252       | 115   | 4.55933 | 138   | 5,800,000 | 41852       | 136   | 4.62172 | 142   |
| 5,360,000 | 36366       | 114   | 4.56070 | 137   | 5,810,000 | 41988       | 136   | 4.62313 | 141   |
| 5,370,000 | 36481       | 115   | 4.56207 | 137   | 5,820,000 | 42124       | 136   | 4.62453 | 140   |
| 5,380,000 | 36597       | 116   | 4.56345 | 138   | 5,830,000 | 42261       | 137   | 4.62591 | 141   |
| 5,390,000 | 36712       | 115   | 4.56481 | 136   | 5,840,000 | 42398       | 137   | 4.62735 | 141   |
| 5,400,000 | 36829       | 117   | 4.56619 | 138   | 5,850,000 | 42537       | 139   | 4.62877 | 142   |
| 5,410,000 | 36945       | 116   | 4.56756 | 137   | 5,860,000 | 42675       | 138   | 4.63017 | 140   |
| 5,420,000 | 37062       | 117   | 4.56893 | 137   | 5,870,000 | 42814       | 139   | 4.63159 | 142   |
| 5,430,000 | 37180       | 118   | 4.57031 | 138   | 5,880,000 | 42954       | 140   | 4.63300 | 141   |
| 5,440,000 | 37298       | 118   | 4.57169 | 138   | 5,890,000 | 43095       | 141   | 4.63443 | 143   |
| 5,450,000 | 37416       | 118   | 4.57306 | 137   | 5,900,000 | 43236       | 141   | 4.63585 | 142   |
| 5,460,000 | 37535       | 119   | 4.57444 | 138   | 5,910,000 | 43377       | 141   | 4.63726 | 141   |
| 5,470,000 | 37654       | 119   | 4.57581 | 137   | 5,920,000 | 43519       | 142   | 4.63868 | 142   |
| 5,480,000 | 37774       | 120   | 4.57719 | 138   | 5,930,000 | 43662       | 143   | 4.64010 | 142   |
| 5,490,000 | 37894       | 120   | 4.57857 | 138   | 5,940,000 | 43805       | 143   | 4.64152 | 142   |
| 5,500,000 | 38015       | 121   | 4.57996 | 139   | 5,950,000 | 43950       | 145   | 4.64296 | 144   |
| 5,510,000 | 38136       | 121   | 4.58134 | 138   | 5,960,000 | 44094       | 144   | 4.64438 | 142   |
| 5,520,000 | 38257       | 121   | 4.58271 | 137   | 5,970,000 | 44239       | 145   | 4.64581 | 143   |
| 5,530,000 | 38379       | 122   | 4.58409 | 138   | 5,980,000 | 44385       | 146   | 4.64724 | 143   |
| 5,540,000 | 38501       | 122   | 4.58547 | 138   | 5,990,000 | 44532       | 147   | 4.64867 | 143   |
| 5,550,000 | 38624       | 123   | 4.58686 | 139   | 6,000,000 | 44679       | 147   | 4.65010 | 143   |
| 5,560,000 | 38747       | 123   | 4.58824 | 138   | 6,010,000 | 44826       | 147   | 4.65153 | 143   |
| 5,570,000 | 38871       | 124   | 4.58963 | 139   | 6,020,000 | 44975       | 149   | 4.65297 | 144   |
| 5,580,000 | 38995       | 124   | 4.59101 | 138   | 6,030,000 | 45124       | 149   | 4.65441 | 144   |
| 5,590,000 | 39120       | 125   | 4.59240 | 139   | 6,040,000 | 45274       | 150   | 4.65585 | 144   |
| 5,600,000 | 39245       | 125   | 4.59378 | 138   | 6,050,000 | 45424       | 150   | 4.65729 | 144   |
| 5,610,000 | 39370       | 125   | 4.59517 | 139   | 6,060,000 | 45575       | 151   | 4.65873 | 144   |
| 5,620,000 | 39496       | 126   | 4.59655 | 138   | 6,070,000 | 45727       | 152   | 4.66017 | 144   |
| 5,630,000 | 39623       | 127   | 4.59795 | 140   | 6,080,000 | 45879       | 152   | 4.66161 | 144   |
| 5,640,000 | 39750       | 127   | 4.59934 | 139   | 6,090,000 | 46032       | 153   | 4.66306 | 145   |
| 5,650,000 | 39878       | 128   | 4.60073 | 139   | 6,100,000 | 46186       | 154   | 4.66451 | 145   |

Table 6. Convergence—Continued

| Northing  | Function XV | Diff. | Log XV  | Diff. | Northing  | Function XV | Diff. | Log XV  | Diff. |
|-----------|-------------|-------|---------|-------|-----------|-------------|-------|---------|-------|
| 6,100,000 | 46186       | 154   | 4.66451 | 145   |           |             |       |         |       |
| 6,110,000 | 46340       | 154   | 4.66596 | 145   | 6,560,000 | 54091       | 192   | 4.73313 | 155   |
| 6,120,000 | 46495       | 155   | 4.66741 | 145   | 6,570,000 | 54284       | 193   | 4.73467 | 154   |
| 6,130,000 | 46651       | 156   | 4.66886 | 145   | 6,580,000 | 54478       | 194   | 4.73622 | 155   |
| 6,140,000 | 46807       | 156   | 4.67031 | 145   | 6,590,000 | 54673       | 195   | 4.73777 | 155   |
| 6,150,000 | 46965       | 158   | 4.67177 | 146   | 6,600,000 | 54869       | 196   | 4.73933 | 156   |
| 6,160,000 | 47123       | 158   | 4.67323 | 146   | 6,610,000 | 55066       | 197   | 4.74088 | 155   |
| 6,170,000 | 47281       | 158   | 4.67469 | 146   | 6,620,000 | 55264       | 198   | 4.74244 | 156   |
| 6,180,000 | 47441       | 160   | 4.67615 | 146   | 6,630,000 | 55463       | 199   | 4.74400 | 156   |
| 6,190,000 | 47601       | 160   | 4.67762 | 147   | 6,640,000 | 55663       | 200   | 4.74557 | 157   |
| 6,200,000 | 47761       | 160   | 4.67907 | 145   | 6,650,000 | 55864       | 201   | 4.74713 | 156   |
| 6,210,000 | 47923       | 162   | 4.68054 | 147   | 6,660,000 | 56067       | 203   | 4.74871 | 158   |
| 6,220,000 | 48078       | 155   | 4.68195 | 141   | 6,670,000 | 56270       | 203   | 4.75028 | 157   |
| 6,230,000 | 48241       | 163   | 4.68342 | 147   | 6,680,000 | 56475       | 205   | 4.75186 | 158   |
| 6,240,000 | 48405       | 164   | 4.68489 | 147   | 6,690,000 | 56681       | 206   | 4.75344 | 158   |
| 6,250,000 | 48570       | 165   | 4.68637 | 148   | 6,700,000 | 56888       | 207   | 4.75502 | 158   |
| 6,260,000 | 48735       | 165   | 4.68784 | 147   | 6,710,000 | 57096       | 208   | 4.75661 | 159   |
| 6,270,000 | 48901       | 166   | 4.68932 | 148   | 6,720,000 | 57305       | 209   | 4.75819 | 158   |
| 6,280,000 | 49068       | 167   | 4.69080 | 148   | 6,730,000 | 57515       | 210   | 4.75978 | 159   |
| 6,290,000 | 49236       | 168   | 4.69228 | 148   | 6,740,000 | 57727       | 212   | 4.76138 | 160   |
| 6,300,000 | 49404       | 168   | 4.69376 | 148   | 6,750,000 | 57940       | 213   | 4.76298 | 160   |
| 6,310,000 | 49574       | 170   | 4.69525 | 149   | 6,760,000 | 58153       | 213   | 4.76457 | 159   |
| 6,320,000 | 49744       | 170   | 4.69674 | 149   | 6,770,000 | 58369       | 216   | 4.76618 | 161   |
| 6,330,000 | 49915       | 171   | 4.69823 | 149   | 6,780,000 | 58585       | 216   | 4.76779 | 161   |
| 6,340,000 | 50087       | 172   | 4.69973 | 150   | 6,790,000 | 58803       | 218   | 4.76940 | 161   |
| 6,350,000 | 50259       | 172   | 4.70121 | 148   | 6,800,000 | 59021       | 218   | 4.77101 | 161   |
| 6,360,000 | 50433       | 174   | 4.70271 | 150   | 6,810,000 | 59241       | 220   | 4.77262 | 161   |
| 6,370,000 | 50607       | 174   | 4.70421 | 150   | 6,820,000 | 59463       | 222   | 4.77425 | 163   |
| 6,380,000 | 50782       | 175   | 4.70571 | 150   | 6,830,000 | 59685       | 222   | 4.77587 | 162   |
| 6,390,000 | 50958       | 176   | 4.70721 | 150   | 6,840,000 | 59909       | 224   | 4.77749 | 162   |
| 6,400,000 | 51135       | 177   | 4.70872 | 151   | 6,850,000 | 60134       | 225   | 4.77912 | 163   |
| 6,410,000 | 51313       | 178   | 4.71023 | 151   | 6,860,000 | 60361       | 227   | 4.78076 | 164   |
| 6,420,000 | 51492       | 179   | 4.71174 | 151   | 6,870,000 | 60589       | 228   | 4.78239 | 163   |
| 6,430,000 | 51671       | 179   | 4.71325 | 151   | 6,880,000 | 60818       | 229   | 4.78403 | 164   |
| 6,440,000 | 51852       | 181   | 4.71477 | 152   | 6,890,000 | 61049       | 231   | 4.78568 | 165   |
| 6,450,000 | 52033       | 181   | 4.71628 | 151   | 6,900,000 | 61281       | 232   | 4.78733 | 165   |
| 6,460,000 | 52215       | 182   | 4.71780 | 152   | 6,910,000 | 61514       | 233   | 4.78897 | 164   |
| 6,470,000 | 52399       | 184   | 4.71932 | 152   | 6,920,000 | 61749       | 235   | 4.79063 | 166   |
| 6,480,000 | 52583       | 184   | 4.72085 | 153   | 6,930,000 | 61985       | 236   | 4.79229 | 166   |
| 6,490,000 | 52768       | 185   | 4.72237 | 152   | 6,940,000 | 62222       | 237   | 4.79394 | 165   |
| 6,500,000 | 52954       | 186   | 4.72390 | 153   | 6,950,000 | 62461       | 239   | 4.79561 | 167   |
| 6,510,000 | 53141       | 187   | 4.72543 | 153   | 6,960,000 | 62702       | 241   | 4.79728 | 167   |
| 6,520,000 | 53329       | 188   | 4.72696 | 153   | 6,970,000 | 62943       | 241   | 4.79895 | 167   |
| 6,530,000 | 53518       | 189   | 4.72850 | 151   | 6,980,000 | 63187       | 244   | 4.80063 | 168   |
| 6,540,000 | 53708       | 190   | 4.73004 | 154   | 6,990,000 | 63432       | 245   | 4.80231 | 168   |
| 6,550,000 | 53899       | 191   | 4.73158 | 154   | 7,000,000 | 63678       | 246   | 4.80399 | 168   |



Table 6. Convergence--Continued

| Northing  | Function XV | Diff. | Log XV  | Diff. | Northing  | Function XV | Diff. | Log XV  | Diff. |
|-----------|-------------|-------|---------|-------|-----------|-------------|-------|---------|-------|
| 7,000,000 | 63878       | 246   | 4.80399 | 168   |           |             |       |         |       |
| 7,010,000 | 63926       | 248   | 4.80568 | 169   | 7,460,000 | 76953       | 336   | 4.88623 | 190   |
| 7,020,000 | 64175       | 249   | 4.80737 | 169   | 7,470,000 | 77292       | 339   | 4.88813 | 190   |
| 7,030,000 | 64426       | 251   | 4.80906 | 169   | 7,480,000 | 77633       | 341   | 4.89005 | 192   |
| 7,040,000 | 64679       | 253   | 4.81076 | 170   | 7,490,000 | 77977       | 344   | 4.89197 | 192   |
| 7,050,000 | 64933       | 254   | 4.81247 | 171   | 7,500,000 | 78324       | 347   | 4.89389 | 192   |
| 7,060,000 | 65189       | 256   | 4.81417 | 170   | 7,510,000 | 78673       | 349   | 4.89583 | 194   |
| 7,070,000 | 65446       | 257   | 4.81588 | 171   | 7,520,000 | 79025       | 352   | 4.89776 | 193   |
| 7,080,000 | 65705       | 259   | 4.81760 | 172   | 7,530,000 | 79380       | 355   | 4.89971 | 195   |
| 7,090,000 | 65966       | 261   | 4.81932 | 172   | 7,540,000 | 79737       | 357   | 4.90166 | 195   |
| 7,100,000 | 66228       | 262   | 4.82104 | 172   | 7,550,000 | 80097       | 360   | 4.90362 | 196   |
| 7,110,000 | 66492       | 264   | 4.82277 | 173   | 7,560,000 | 80460       | 363   | 4.90558 | 196   |
| 7,120,000 | 66758       | 266   | 4.82450 | 173   | 7,570,000 | 80826       | 366   | 4.90755 | 197   |
| 7,130,000 | 67025       | 267   | 4.82624 | 174   | 7,580,000 | 81195       | 369   | 4.90953 | 198   |
| 7,140,000 | 67295       | 270   | 4.82798 | 174   | 7,590,000 | 81566       | 371   | 4.91151 | 198   |
| 7,150,000 | 67566       | 271   | 4.82973 | 175   | 7,600,000 | 81941       | 375   | 4.91350 | 199   |
| 7,160,000 | 67838       | 272   | 4.83147 | 174   | 7,610,000 | 82318       | 377   | 4.91549 | 199   |
| 7,170,000 | 68113       | 275   | 4.83323 | 176   | 7,620,000 | 82699       | 381   | 4.91750 | 201   |
| 7,180,000 | 68389       | 276   | 4.83499 | 176   | 7,630,000 | 83082       | 383   | 4.91951 | 201   |
| 7,190,000 | 68667       | 278   | 4.83675 | 176   | 7,640,000 | 83469       | 387   | 4.92153 | 202   |
| 7,200,000 | 68947       | 280   | 4.83852 | 177   | 7,650,000 | 83859       | 390   | 4.92355 | 202   |
| 7,210,000 | 69229       | 282   | 4.84029 | 177   | 7,660,000 | 84252       | 393   | 4.92558 | 203   |
| 7,220,000 | 69513       | 284   | 4.84207 | 178   | 7,670,000 | 84648       | 396   | 4.92762 | 204   |
| 7,230,000 | 69799       | 286   | 4.84385 | 178   | 7,680,000 | 85048       | 400   | 4.92966 | 204   |
| 7,240,000 | 70087       | 288   | 4.84564 | 179   | 7,690,000 | 85450       | 402   | 4.93171 | 205   |
| 7,250,000 | 70376       | 289   | 4.84742 | 178   | 7,700,000 | 85857       | 407   | 4.93378 | 207   |
| 7,260,000 | 70668       | 292   | 4.84922 | 180   | 7,710,000 | 86266       | 409   | 4.93584 | 206   |
| 7,270,000 | 70962       | 294   | 4.85103 | 181   | 7,720,000 | 86679       | 413   | 4.93791 | 207   |
| 7,280,000 | 71257       | 295   | 4.85283 | 180   | 7,730,000 | 87096       | 417   | 4.94000 | 209   |
| 7,290,000 | 71555       | 298   | 4.85464 | 181   | 7,740,000 | 87516       | 420   | 4.94209 | 209   |
| 7,300,000 | 71855       | 300   | 4.85646 | 182   | 7,750,000 | 87939       | 423   | 4.94418 | 209   |
| 7,310,000 | 72157       | 302   | 4.85828 | 182   | 7,760,000 | 88367       | 428   | 4.94629 | 211   |
| 7,320,000 | 72461       | 304   | 4.86010 | 182   | 7,770,000 | 88797       | 430   | 4.94840 | 211   |
| 7,330,000 | 72767       | 306   | 4.86193 | 183   | 7,780,000 | 89232       | 435   | 4.95052 | 212   |
| 7,340,000 | 73075       | 308   | 4.86377 | 184   | 7,790,000 | 89670       | 438   | 4.95265 | 213   |
| 7,350,000 | 73386       | 311   | 4.86561 | 184   | 7,800,000 | 90113       | 443   | 4.95479 | 214   |
| 7,360,000 | 73698       | 312   | 4.86746 | 185   | 7,810,000 | 90559       | 446   | 4.95693 | 214   |
| 7,370,000 | 74013       | 315   | 4.86931 | 185   | 7,820,000 | 91009       | 450   | 4.95908 | 215   |
| 7,380,000 | 74330       | 317   | 4.87116 | 185   | 7,830,000 | 91463       | 454   | 4.96125 | 217   |
| 7,390,000 | 74650       | 320   | 4.87303 | 187   | 7,840,000 | 91921       | 458   | 4.96341 | 216   |
| 7,400,000 | 74972       | 322   | 4.87490 | 187   | 7,850,000 | 92383       | 462   | 4.96559 | 218   |
| 7,410,000 | 75296       | 324   | 4.87677 | 187   | 7,860,000 | 92849       | 466   | 4.96778 | 219   |
| 7,420,000 | 75623       | 327   | 4.87865 | 188   | 7,870,000 | 93320       | 471   | 4.96997 | 219   |
| 7,430,000 | 75952       | 329   | 4.88054 | 189   | 7,880,000 | 93795       | 475   | 4.97218 | 221   |
| 7,440,000 | 76283       | 331   | 4.88243 | 189   | 7,890,000 | 94274       | 479   | 4.97439 | 221   |
| 7,450,000 | 76617       | 334   | 4.88433 | 190   | 7,900,000 | 94758       | 484   | 4.97662 | 223   |

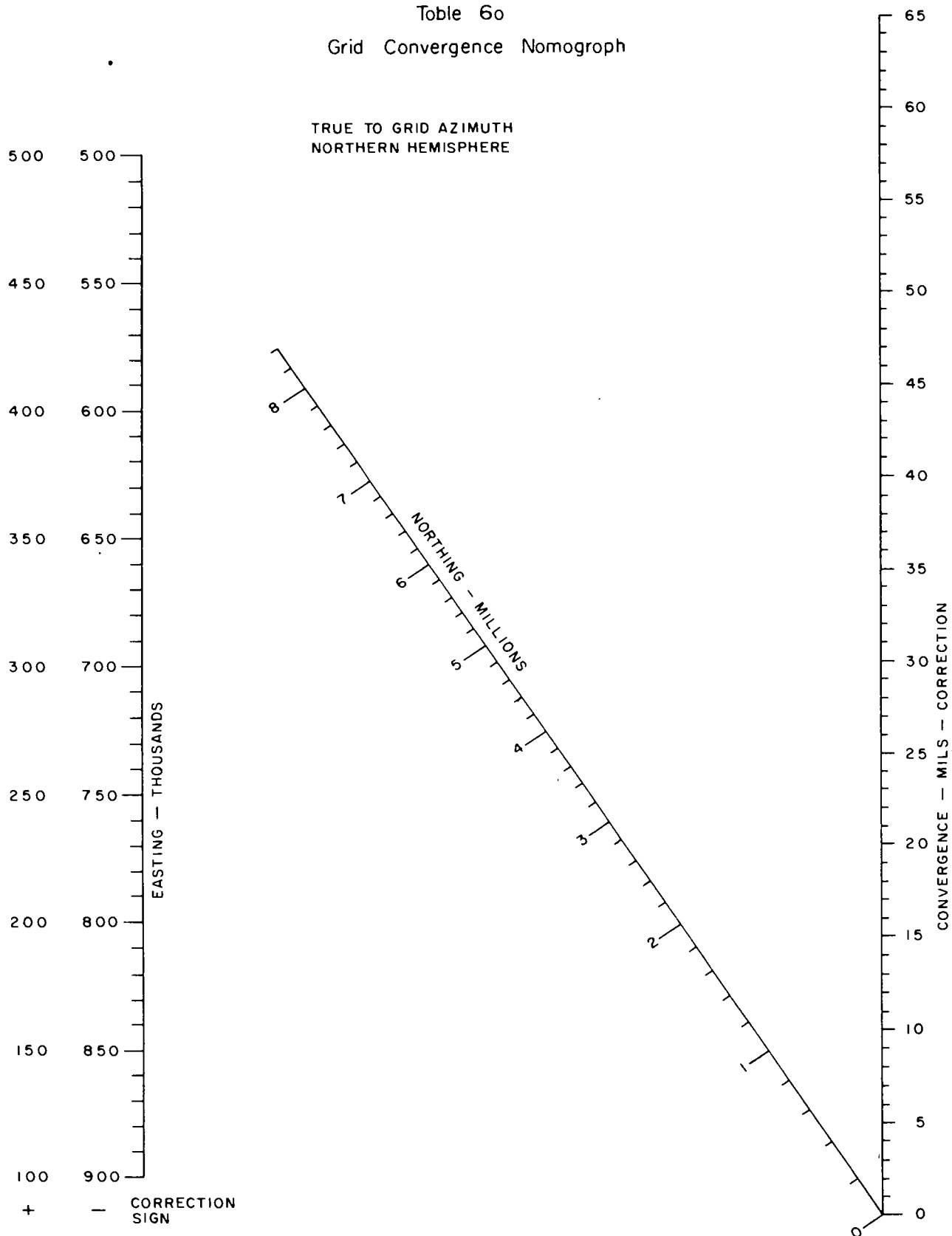
Table 6. Convergence—Continued

| Northing  | Function XV | Diff. | Log XV   | Diff. | Northing  | Function XV | Diff. | Log XV   | Diff. |
|-----------|-------------|-------|----------|-------|-----------|-------------|-------|----------|-------|
| 7,900,000 | 94758       | 484   | 4.97862  | 223   |           |             |       |          |       |
| 7,910,000 | 95246       | 488   | 4.97885  | 223   | 8,360,000 | 123153      | 782   | 5.090445 | 2766  |
| 7,920,000 | 95738       | 492   | 4.98108  | 223   | 8,370,000 | 123943      | 790   | 5.093222 | 2777  |
| 7,930,000 | 96235       | 497   | 4.98333  | 225   | 8,380,000 | 124743      | 800   | 5.096016 | 2794  |
| 7,940,000 | 96737       | 502   | 4.98559  | 226   | 8,390,000 | 125553      | 810   | 5.098827 | 2811  |
| 7,950,000 | 97244       | 507   | 4.98786  | 227   | 8,400,000 | 126372      | 819   | 5.101651 | 2824  |
|           |             |       |          |       |           |             |       |          |       |
| 7,960,000 | 97755       | 511   | 4.99014  | 228   | 8,410,000 | 127202      | 830   | 5.104404 | 2843  |
| 7,970,000 | 98271       | 516   | 4.99243  | 229   | 8,420,000 | 128042      | 840   | 5.107352 | 2858  |
| 7,980,000 | 98792       | 521   | 4.99472  | 229   | 8,430,000 | 128893      | 851   | 5.110229 | 2877  |
| 7,990,000 | 99318       | 526   | 4.99703  | 231   | 8,440,000 | 129754      | 861   | 5.113121 | 2892  |
| 8,000,000 | 99850       | 532   | 4.99935  | 232   | 8,450,000 | 130626      | 872   | 5.116030 | 2909  |
|           |             |       |          |       |           |             |       |          |       |
| 8,010,000 | 100386      | 536   | 5.001673 | 2323  | 8,460,000 | 131510      | 884   | 5.118959 | 2929  |
| 8,020,000 | 100928      | 542   | 5.004012 | 2339  | 8,470,000 | 132404      | 894   | 5.121901 | 2942  |
| 8,030,000 | 101475      | 547   | 5.006369 | 2347  | 8,480,000 | 133310      | 906   | 5.124863 | 2962  |
| 8,040,000 | 102027      | 552   | 5.008715 | 2356  | 8,490,000 | 134228      | 918   | 5.127843 | 2980  |
| 8,050,000 | 102585      | 558   | 5.011084 | 2369  | 8,500,000 | 135158      | 930   | 5.130842 | 2999  |
|           |             |       |          |       |           |             |       |          |       |
| 8,060,000 | 103149      | 564   | 5.013465 | 2381  | 8,510,000 | 136101      | 943   | 5.133861 | 3019  |
| 8,070,000 | 103718      | 569   | 5.015854 | 2389  | 8,520,000 | 137055      | 954   | 5.136895 | 3034  |
| 8,080,000 | 104293      | 575   | 5.018255 | 2401  | 8,530,000 | 138023      | 968   | 5.139951 | 3056  |
| 8,090,000 | 104873      | 580   | 5.020664 | 2409  | 8,540,000 | 139003      | 980   | 5.143024 | 3073  |
| 8,100,000 | 105460      | 587   | 5.023088 | 2424  | 8,550,000 | 139997      | 994   | 5.146119 | 3095  |
|           |             |       |          |       |           |             |       |          |       |
| 8,110,000 | 106053      | 593   | 5.025523 | 2435  | 8,560,000 | 141005      | 1008  | 5.149235 | 3116  |
| 8,120,000 | 106651      | 598   | 5.027965 | 2442  | 8,570,000 | 142026      | 1021  | 5.152368 | 3133  |
| 8,130,000 | 107256      | 605   | 5.030422 | 2457  | 8,580,000 | 143062      | 1036  | 5.155524 | 3156  |
| 8,140,000 | 107868      | 612   | 5.032893 | 2471  | 8,590,000 | 144112      | 1050  | 5.158700 | 3176  |
| 8,150,000 | 108486      | 618   | 5.035374 | 2481  | 8,600,000 | 145176      | 1064  | 5.161895 | 3195  |
|           |             |       |          |       |           |             |       |          |       |
| 8,160,000 | 109110      | 624   | 5.037865 | 2491  | 8,610,000 | 146250      | 1080  | 5.165114 | 3219  |
| 8,170,000 | 109741      | 631   | 5.040369 | 2504  | 8,620,000 | 147351      | 1095  | 5.168353 | 3239  |
| 8,180,000 | 110379      | 638   | 5.042886 | 2517  | 8,630,000 | 148462      | 1111  | 5.171615 | 3262  |
| 8,190,000 | 111023      | 644   | 5.045413 | 2527  | 8,640,000 | 149590      | 1128  | 5.174903 | 3288  |
| 8,200,000 | 111675      | 652   | 5.047956 | 2543  | 8,650,000 | 150733      | 1143  | 5.178208 | 3305  |
|           |             |       |          |       |           |             |       |          |       |
| 8,210,000 | 112333      | 658   | 5.050507 | 2551  | 8,660,000 | 151894      | 1161  | 5.181541 | 3333  |
| 8,220,000 | 112999      | 666   | 5.053075 | 2568  | 8,670,000 | 153071      | 1177  | 5.184893 | 3352  |
| 8,230,000 | 113672      | 673   | 5.055654 | 2579  | 8,680,000 | 154267      | 1196  | 5.188273 | 3380  |
| 8,240,000 | 114353      | 681   | 5.058248 | 2594  | 8,690,000 | 155480      | 1213  | 5.191675 | 3402  |
| 8,250,000 | 115041      | 688   | 5.060853 | 2605  | 8,700,000 | 156712      | 1232  | 5.195102 | 3427  |
|           |             |       |          |       |           |             |       |          |       |
| 8,260,000 | 115737      | 696   | 5.063472 | 2619  | 8,710,000 | 157962      | 1250  | 5.198553 | 3451  |
| 8,270,000 | 116441      | 704   | 5.066106 | 2634  | 8,720,000 | 159232      | 1270  | 5.202030 | 3477  |
| 8,280,000 | 117153      | 712   | 5.068753 | 2647  | 8,730,000 | 160522      | 1290  | 5.205535 | 3505  |
| 8,290,000 | 117873      | 720   | 5.071414 | 2661  | 8,740,000 | 161831      | 1309  | 5.209062 | 3527  |
| 8,300,000 | 118601      | 728   | 5.074088 | 2674  | 8,750,000 | 163162      | 1331  | 5.212619 | 3557  |
|           |             |       |          |       |           |             |       |          |       |
| 8,310,000 | 119338      | 737   | 5.076779 | 2691  | 8,760,000 | 164514      | 1352  | 5.216203 | 3584  |
| 8,320,000 | 120083      | 745   | 5.079482 | 2703  | 8,770,000 | 165887      | 1373  | 5.219812 | 3609  |
| 8,330,000 | 120837      | 754   | 5.082200 | 2718  | 8,780,000 | 167283      | 1396  | 5.223452 | 3640  |
| 8,340,000 | 121600      | 763   | 5.084931 | 2734  | 8,790,000 | 168702      | 1419  | 5.227120 | 3668  |
| 8,350,000 | 122371      | 771   | 5.087679 | 2745  | 8,800,000 | 170144      | 1442  | 5.230817 | 3697  |

Table 6. Convergence—Continued

| Northing  | Function XV | Diff. | Log XV   | Diff. | Northing  | Function XV | Diff. | Log XV   | Diff. |
|-----------|-------------|-------|----------|-------|-----------|-------------|-------|----------|-------|
| 8,800,000 | 170144      | 1442  | 5.230817 | 3607  |           |             |       |          |       |
| 8,810,000 | 171610      | 1406  | 5.234543 | 3726  | 8,860,000 | 179322      | 1500  | 5.253034 | 3883  |
| 8,820,000 | 173100      | 1400  | 5.238297 | 3754  | 8,870,000 | 180948      | 1023  | 5.257547 | 3013  |
| 8,830,000 | 174610      | 1516  | 5.242084 | 3787  | 8,880,000 | 182597      | 1652  | 5.261404 | 3947  |
| 8,840,000 | 176168      | 1542  | 5.245902 | 3818  | 8,890,000 | 184279      | 1082  | 5.265470 | 3982  |
| 8,850,000 | 177726      | 1568  | 5.249751 | 3840  | 8,900,000 | 185991      | 1712  | 5.269492 | 4016  |

Table 6a  
Grid Convergence Nomograph



FOR SOUTHERN HEMISPHERE, SUBTRACT NORTHING FROM 10,000,000  
USE OPPOSITE SIGN OF CORRECTION

Table 7. Second Term in Convergence Computation, UTM Coordinates

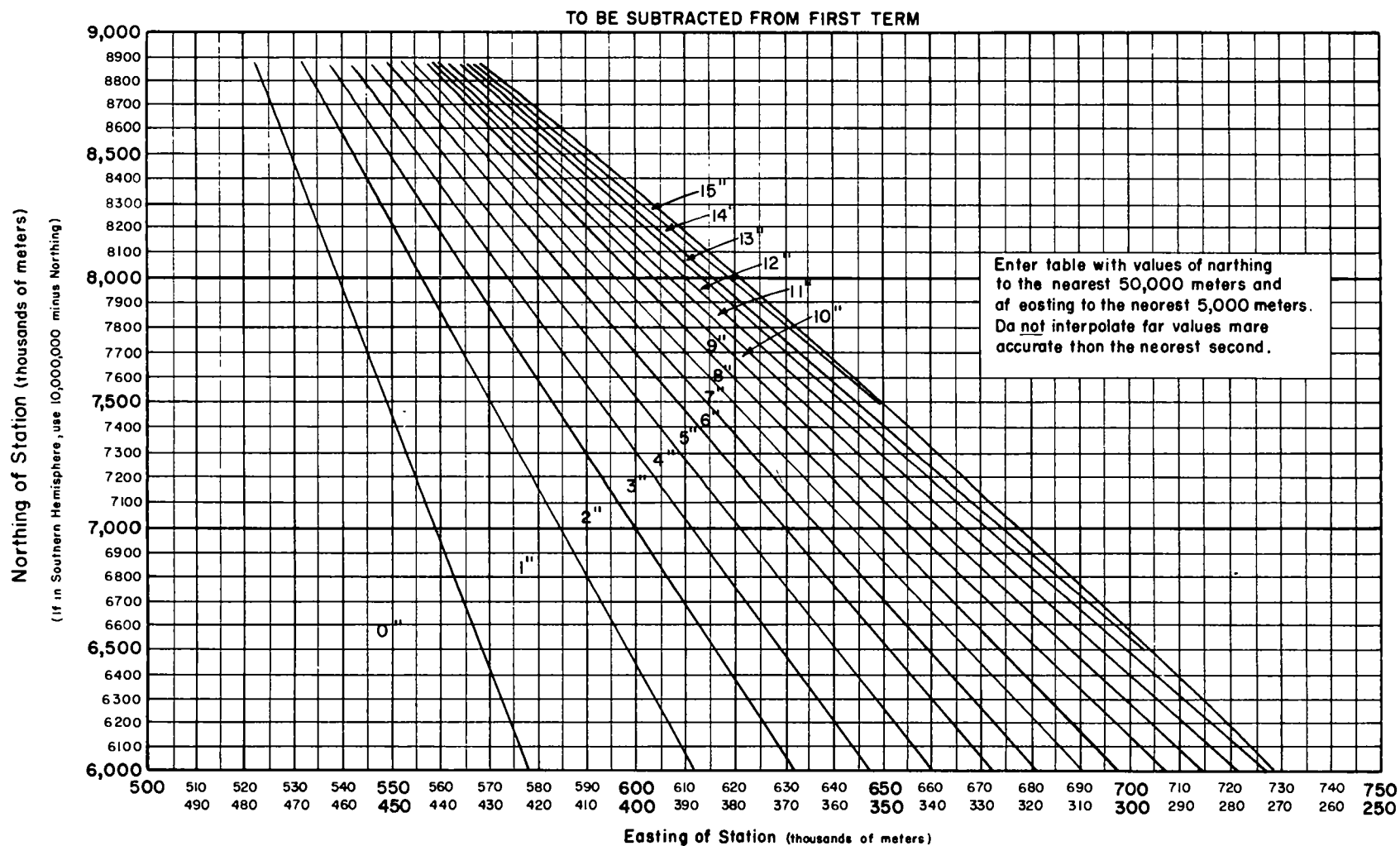
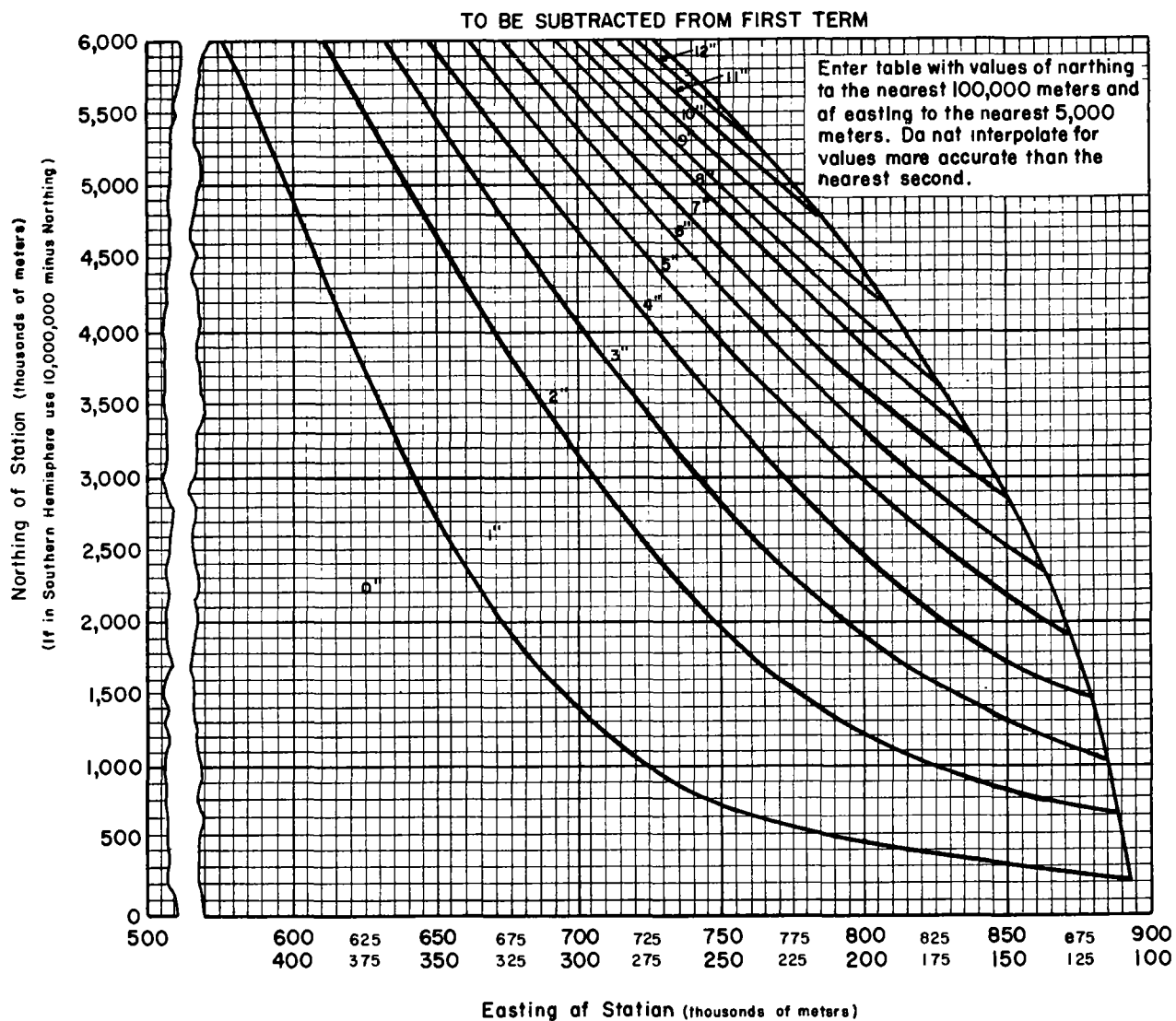


Table 7. Second Term in Convergence Computation, UTM Coordinates -- Continued



| CONVERSION TABLE |        |
|------------------|--------|
| 1"               | 0.00 m |
| 2"               | 0.01 m |
| 3"               | 0.01 m |
| 4"               | 0.02 m |
| 5"               | 0.02 m |
| 6"               | 0.03 m |
| 7"               | 0.03 m |
| 8"               | 0.04 m |
| 9"               | 0.04 m |
| 10"              | 0.05 m |
| 11"              | 0.05 m |
| 12"              | 0.06 m |
| 13"              | 0.06 m |
| 14"              | 0.07 m |
| 15"              | 0.07 m |

Table 8a. Second Term in Convergenge Computation, Geographic Coordinates (Degrees)

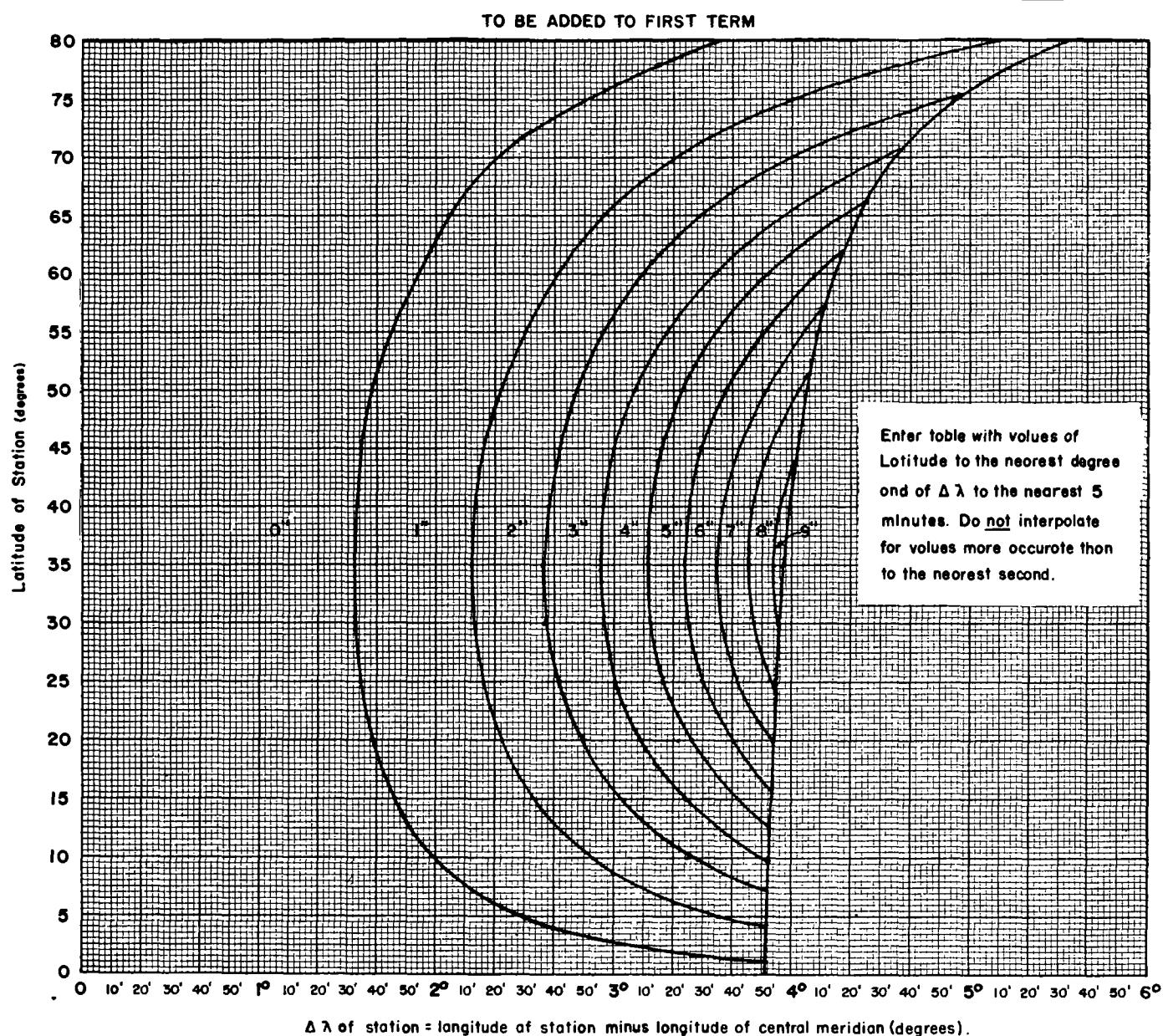


Table 8b. Second Term in Convergence Computation, Geographic Coordinates (Mils)  
TO BE ADDED TO FIRST TERM

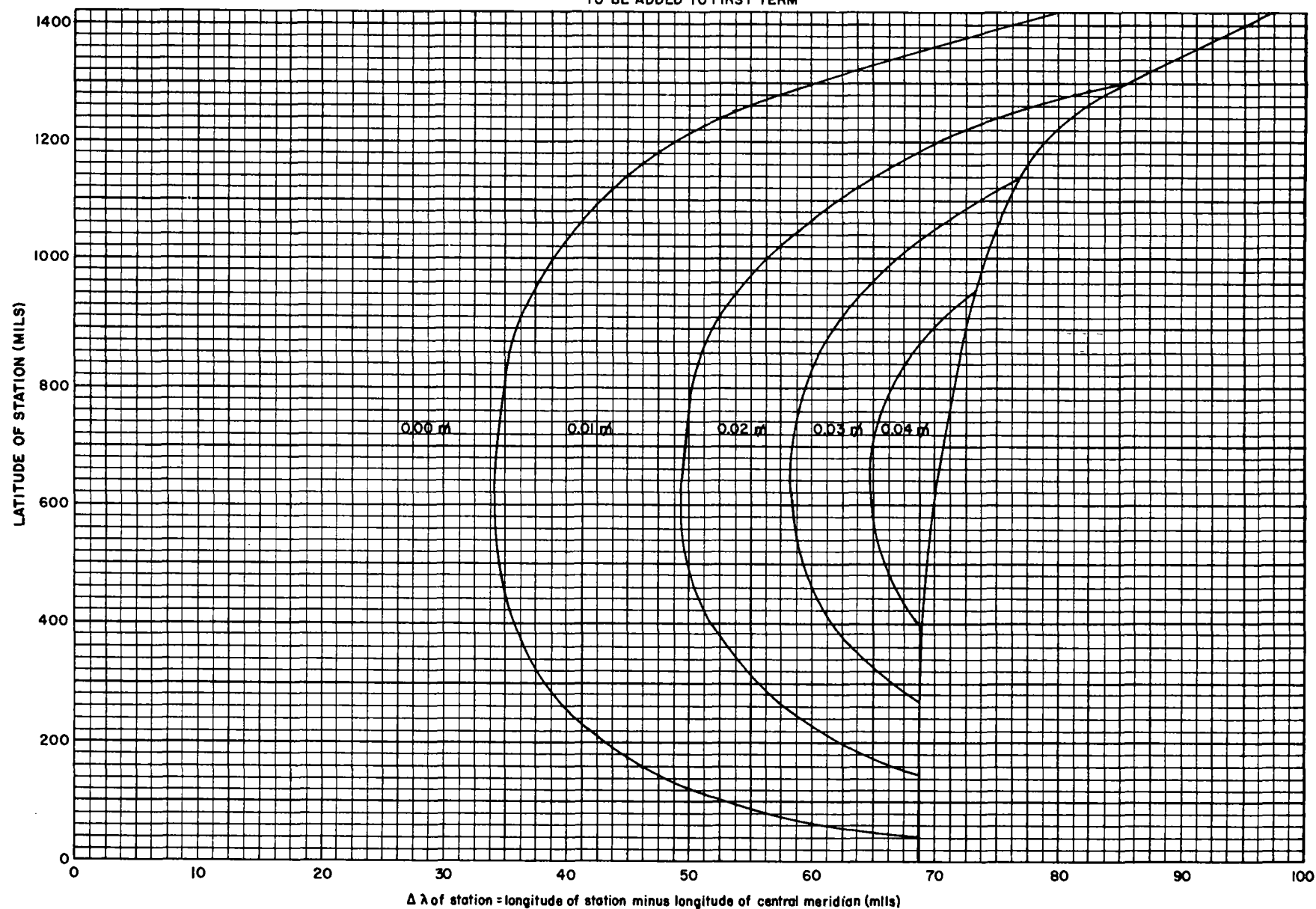




Table 9. Alphabetical Star List

Enter table with name of star to obtain the number for use in entering table 10a, 10b, or 11.

| Star                                                     | Constellation            | No. | Magnitude |
|----------------------------------------------------------|--------------------------|-----|-----------|
| Acamar, Theta ( $\theta$ ) Eridani.....                  | Eridanus.....            | 12  | 3.4       |
| Achernar, Alpha ( $\alpha$ ) Eridani.....                | Eridanus.....            | 9   | 0.6       |
| Acrux, Alpha ( $\alpha$ ) Crucis.....                    | Crux.....                | 42  | 1.0       |
| Adhara, Epsilon ( $\epsilon$ ) Canis Majoris.....        | Canis Major.....         | 26  | 1.6       |
| Aldebaran, Alpha ( $\alpha$ ) Tauri.....                 | Taurus.....              | 15  | 1.1       |
| Alhena, Gamma ( $\gamma$ ) Geminorum*.....               | Gemini.....              | 24  | 1.9       |
| Alioth, Epsilon ( $\epsilon$ ) Ursae Majoris.....        | Ursa Major.....          | 45  | 1.7       |
| Alkaid, (Benetnasch), Eta ( $\eta$ ) Ursae Majoris.....  | Ursa Major.....          | 48  | 1.9       |
| Al Na'ir, Alpha ( $\alpha$ ) Gruis.....                  | Gruis.....               | 71  | 2.2       |
| Alnilam, Epsilon ( $\epsilon$ ) Orionis.....             | Orion.....               | 20  | 1.7       |
| Alnitak, Zeta ( $\zeta$ ) Orionis*.....                  | Orion.....               | 21  | 2.0       |
| Alpha ( $\alpha$ ) Ceti, Menkar**.....                   | Cetus.....               | 13  | 2.8       |
| Alpha ( $\alpha$ ) Persei, Mirfak.....                   | Perseus.....             | 14  | 1.9       |
| Alpha ( $\alpha$ ) Tri Aust, Atria.....                  | Triangulum Australe..... | 58  | 1.9       |
| Alphard, Alpha ( $\alpha$ ) Hydrae.....                  | Hydra.....               | 35  | 2.2       |
| Alphecca, Alpha ( $\alpha$ ) Coronae Bor.....            | Corona Borealis.....     | 55  | 2.3       |
| Alpheratz, Alpha ( $\alpha$ ) Andromedae.....            | Andromeda.....           | 1   | 2.1       |
| (Al Suhail), Suhail, Lambda ( $\lambda$ ) Velorum.....   | Vela (Argo).....         | 33  | 2.2       |
| Altair, Alpha ( $\alpha$ ) Aquilae.....                  | Aquila.....              | 66  | 0.9       |
| Ankaa, Alpha ( $\alpha$ ) Phoenix**.....                 | Phoenix.....             | 4   | 2.4       |
| Antares, Alpha ( $\alpha$ ) Scorpii.....                 | Scorpius.....            | 57  | 1.2       |
| Arcturus, Alpha ( $\alpha$ ) Bootis.....                 | Bootes.....              | 51  | 0.2       |
| Atria, Alpha ( $\alpha$ ) Tri Aust.....                  | Triangulum Australe..... | 58  | 1.9       |
| Avior, Epsilon ( $\epsilon$ ) Carinae.....               | Carina (Argo, Vela)..... | 32  | 1.7       |
| Bellatrix, Gamma ( $\gamma$ ) Orionis.....               | Orion.....               | 18  | 1.7       |
| Beta ( $\beta$ ) Centauri, Hadar.....                    | Centaurus.....           | 49  | 0.9       |
| Beta ( $\beta$ ) Crucis, Mimosa*.....                    | Crux.....                | 44  | 1.5       |
| Beta ( $\beta$ ) Hydri***.....                           | Hydra.....               | 3   | 2.9       |
| Betelgeuse, (Betelgeux), Alpha ( $\alpha$ ) Orionis..... | Orion.....               | 22  | 0.1       |
| Canopus, Alpha ( $\alpha$ ) Carinae.....                 | Carina (Argo, Vela)..... | 23  | -0.6      |
| Capella, Alpha ( $\alpha$ ) Aurigae.....                 | Auriga.....              | 17  | 0.2       |
| Caph, Beta ( $\beta$ ) Cassiopeiae*.....                 | Cassiopeia.....          | 2   | 2.4       |
| Castor, Alpha ( $\alpha$ ) Geminorum*.....               | Gemini.....              | 28  | 1.6       |
| Delta ( $\delta$ ) Canis Majoris, Wezen*.....            | Canis Major.....         | 27  | 2.0       |
| Deneb, Alpha ( $\alpha$ ) Cygni.....                     | Cygnus.....              | 68  | 1.3       |
| Denebola, Beta ( $\beta$ ) Leonis.....                   | Leo.....                 | 39  | 2.2       |
| Diphda, (Deneb Kaitos), Beta ( $\beta$ ) Ceti.....       | Cetus.....               | 6   | 2.2       |
| Dschubba, Delta ( $\delta$ ) Scorpii**.....              | Scorpius.....            | 56  | 2.5       |
| Dubhe, Alpha ( $\alpha$ ) Ursae Majoris.....             | Ursa Major.....          | 38  | 1.9       |
| Elnath, (El Nath), Beta ( $\beta$ ) Tauri.....           | Taurus.....              | 19  | 1.8       |
| Eltanin, (Eltamin), Gamma ( $\gamma$ ) Draconis.....     | Draco.....               | 62  | 2.4       |
| Enif, Epsilon ( $\epsilon$ ) Pegasi.....                 | Pegasus.....             | 70  | 2.5       |
| Epsilon ( $\epsilon$ ) Carinae, Avior.....               | Carina (Argo, Vela)..... | 32  | 1.7       |
| Fomalhaut, Alpha ( $\alpha$ ) Piscis Austrini.....       | Piscis Austrinus.....    | 72  | 1.3       |
| Gacrux, Gamma ( $\gamma$ ) Crucis.....                   | Crux.....                | 43  | 1.6       |
| Gamma ( $\gamma$ ) Cassiopeiae*.....                     | Cassiopeia.....          | 7   | 1.6-2.8   |
| Gamma ( $\gamma$ ) Velorum, (Gamma Argus)*.....          | Vela (Argo).....         | 31  | 1.9       |
| Gamma ( $\gamma$ ) Geminorum, Alhena*.....               | Gemini.....              | 24  | 1.9       |
| Gienah, Gamma ( $\gamma$ ) Corvi**.....                  | Corvus.....              | 41  | 2.8       |
| Hadar, Beta ( $\beta$ ) Centauri.....                    | Centaurus.....           | 49  | 0.9       |
| Hamal, Alpha ( $\alpha$ ) Arietis.....                   | Aries.....               | 11  | 2.2       |
| Kaus Australis, Epsilon ( $\epsilon$ ) Sagittarii.....   | Sagitta.....             | 63  | 1.9       |
| Kochab, Beta ( $\beta$ ) Ursa Minoris.....               | Ursa Minor.....          | 54  | 2.2       |
| Markab, Alpha ( $\alpha$ ) Pegasi.....                   | Pegasus.....             | 73  | 2.6       |
| Menkar, Alpha ( $\alpha$ ) Ceti**.....                   | Cetus.....               | 13  | 2.8       |
| Menkent, Theta ( $\theta$ ) Centauri.....                | Centaurus.....           | 50  | 2.3       |
| Merak, Beta ( $\beta$ ) Ursae Majoris*.....              | Ursa Major.....          | 37  | 2.4       |

Table 9. Alphabetical Star List—Continued

| Star                                                    | Constellation      | No. | Magnitude |
|---------------------------------------------------------|--------------------|-----|-----------|
| Miaplacidus, Beta ( $\beta$ ) Carinae.....              | Carina (Argo)..... | 34  | 1.8       |
| Mimosa, Beta ( $\beta$ ) Crucis*.....                   | Crux.....          | 44  | 1.5       |
| Mirfak, (Marfak), Alpha ( $\alpha$ ) Persei.....        | Perseus.....       | 14  | 1.9       |
| Mizar, Zeta ( $\zeta$ ) Ursae Majoris*.....             | Ursa Major.....    | 46  | 2.4       |
| Nunki, Sigma ( $\sigma$ ) Sagittarii.....               | Sagitta.....       | 65  | 2.1       |
| (Octantis), Nu ( $\nu$ ) Octantis***.....               | Octans.....        | 69  | 3.7       |
| Peacock, Alpha ( $\alpha$ ) Pavonis.....                | Pavo.....          | 67  | 2.1       |
| Phceda, Gamma ( $\gamma$ ) Ursae Majoris*.....          | Ursa Major.....    | 40  | 2.5       |
| Polaris, Alpha ( $\alpha$ ) Ursae Minoris***.....       | Ursa Minor.....    | 10  | 2.1       |
| Pollux, Beta ( $\beta$ ) Geminorum.....                 | Gemini.....        | 30  | 1.2       |
| Procyon, Alpha ( $\alpha$ ) Canis Minoris.....          | Canis Minor.....   | 29  | 0.5       |
| Rasalhague, Alpha ( $\alpha$ ) Ophiuchi.....            | Ophiuchus.....     | 61  | 2.1       |
| Regulus, Alpha ( $\alpha$ ) Leonis.....                 | Leo.....           | 36  | 1.3       |
| Rigel, Beta ( $\beta$ ) Orionis.....                    | Orion.....         | 16  | 0.3       |
| Rigel Kentaurus, Alpha ( $\alpha$ ) Centauri.....       | Centaurus.....     | 52  | 0.1       |
| Ruchbah, Delta ( $\delta$ ) Cassiopeiae*.....           | Cassiopeia.....    | 8   | 2.8       |
| Sabik, Eta ( $\eta$ ) Ophiuchi.....                     | Ophiuchus.....     | 59  | 2.6       |
| Scaula, (Shaula), Lambda ( $\lambda$ ) Scorpii.....     | Scorpius.....      | 60  | 1.7       |
| Schedar, (Schedir), Alpha ( $\alpha$ ) Cassiopeiae..... | Cassiopeia.....    | 5   | 2.3       |
| Sirius, Alpha ( $\alpha$ ) Canis Majoris.....           | Canis Major.....   | 25  | -1.6      |
| Spica, Alpha ( $\alpha$ ) Virginis.....                 | Virgo.....         | 47  | 1.2       |
| Suhail, (Al Suhail), Lambda ( $\lambda$ ) Velorum.....  | Vela (Argo).....   | 33  | 2.2       |
| Theta ( $\theta$ ) Centauri, Menkent.....               | Centaurus.....     | 50  | 2.3       |
| Vega, Alpha ( $\alpha$ ) Lyrae.....                     | Lyra.....          | 64  | 0.1       |
| Wezen, Delta ( $\delta$ ) Canis Majoris*.....           | Canis Major.....   | 27  | 2.0       |
| Zeta ( $\zeta$ ) Orionis, Alnitak*.....                 | Orion.....         | 21  | 2.0       |
| Zebenelgenubi, Alpha ( $\alpha$ ) Librae**.....         | Libra.....         | 53  | 2.9       |

Note. Sirius (magnitude—1.6) is the brightest star listed, Octantis (magnitude 3.7) is the dimmest star listed. Brightness of other stars listed is indicated by their magnitude.

Spelled out names in parentheses are names sometimes used but not recommended.

\* Indicates star not on identifier 2012D.

\*\* Indicates star not on identifier 2012C.

\*\*\* Indicates star not on either identifier.

The constellation Argus has been replaced by its three modern divisions Carina, Puppis, and Vela.

**Table 10a. Apparent Places of Stars, 1976 (Degrees)**

| STAR<br>NO. | Right<br>ascension<br><br>Declination |                | (Hr Min)<br><br>( ° ' ) | Zero hours universal time (GMT) of first day of month |             |            |            |            |            |            |            |            |            |             |             |
|-------------|---------------------------------------|----------------|-------------------------|-------------------------------------------------------|-------------|------------|------------|------------|------------|------------|------------|------------|------------|-------------|-------------|
|             | Jan                                   | Feb            |                         | Mar                                                   | Apr         | May        | Jun        | Jul        | Aug        | Sep        | Oct        | Nov        | Dec        | Jan         |             |
|             | Seconds (time of RA; arc of DEC)      |                |                         |                                                       |             |            |            |            |            |            |            |            |            |             |             |
| 1           | RA<br>DEC                             | 0 7<br>28 57   | 9.5<br>43               | 9.0<br>39                                             | 8.8<br>34   | 8.9<br>30  | 9.4<br>28  | 10.3<br>30 | 11.3<br>35 | 12.2<br>42 | 12.9<br>49 | 13.2<br>56 | 13.1<br>60 | 12.8<br>62  | 12.3<br>61  |
| 2           | RA<br>DEC                             | 0 7<br>59 0    | 54.5<br>85              | 53.6<br>81                                            | 53.0<br>74  | 53.0<br>65 | 53.8<br>59 | 55.2<br>58 | 56.7<br>61 | 58.1<br>68 | 59.1<br>77 | 59.5<br>88 | 59.2<br>97 | 58.6<br>102 | 57.6<br>103 |
| 3           | RA<br>DFC                             | 0 24<br>-77 22 | 29.2<br>97              | 26.7<br>92                                            | 25.1<br>84  | 24.7<br>72 | 25.7<br>61 | 28.0<br>52 | 31.0<br>48 | 34.2<br>48 | 36.5<br>54 | 37.3<br>63 | 36.5<br>72 | 34.3<br>78  | 31.5<br>79  |
| 4           | RA<br>DEC                             | 0 25<br>-42 25 | 6.4<br>81               | 5.8<br>79                                             | 5.4<br>74   | 5.4<br>66  | 5.8<br>57  | 6.7<br>48  | 7.8<br>42  | 8.9<br>40  | 9.7<br>42  | 10.1<br>47 | 10.0<br>55 | 9.5<br>61   | 8.9<br>63   |
| 5           | RA<br>DFC                             | 0 39<br>56 24  | 9.7<br>42               | 8.8<br>39                                             | 8.2<br>33   | 8.1<br>25  | 8.6<br>19  | 9.8<br>16  | 11.3<br>18 | 12.7<br>25 | 13.8<br>34 | 14.3<br>43 | 14.3<br>52 | 13.8<br>58  | 13.0<br>60  |
| 6           | RA<br>DFC                             | 0 42<br>-18 6  | 23.8<br>69              | 23.4<br>70                                            | 23.1<br>68  | 23.1<br>64 | 23.4<br>58 | 24.1<br>51 | 25.1<br>45 | 26.0<br>40 | 26.7<br>39 | 27.1<br>40 | 27.1<br>44 | 26.9<br>48  | 26.5<br>51  |
| 7           | RA<br>DFC                             | 0 55<br>60 35  | 16.8<br>35              | 15.7<br>33                                            | 14.9<br>27  | 14.7<br>18 | 15.2<br>11 | 16.5<br>8  | 18.1<br>9  | 19.7<br>15 | 20.9<br>23 | 21.6<br>33 | 21.7<br>42 | 21.2<br>49  | 20.3<br>52  |
| 8           | RA<br>DEC                             | 1 24<br>60 6   | 16.3<br>60              | 15.2<br>59                                            | 14.4<br>53  | 14.0<br>45 | 14.3<br>38 | 15.5<br>34 | 17.0<br>34 | 18.6<br>39 | 20.0<br>46 | 20.8<br>56 | 21.1<br>65 | 20.8<br>72  | 20.0<br>76  |
| 9           | RA<br>DEC                             | 1 36<br>-57 20 | 50.0<br>105             | 49.0<br>105                                           | 48.1<br>100 | 47.6<br>91 | 47.7<br>81 | 48.4<br>70 | 49.6<br>62 | 51.0<br>59 | 52.3<br>61 | 53.0<br>67 | 53.2<br>76 | 52.7<br>84  | 51.8<br>89  |

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**See Table 11. Apparent Places of Polaris, 1976**

|    |           |                |            |            |            |            |            |            |            |            |            |            |            |            |            |
|----|-----------|----------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| 11 | RA<br>DEC | 2 5<br>23 20   | 50.6<br>66 | 50.2<br>65 | 49.7<br>62 | 49.4<br>59 | 49.6<br>57 | 50.2<br>58 | 51.0<br>61 | 52.0<br>66 | 52.9<br>71 | 53.6<br>76 | 53.9<br>79 | 54.0<br>80 | 53.7<br>80 |
| 12 | RA<br>DEC | 2 57<br>-40 23 | 22.4<br>74 | 21.8<br>77 | 21.1<br>76 | 20.5<br>71 | 20.3<br>63 | 20.6<br>53 | 21.3<br>44 | 22.4<br>38 | 23.4<br>36 | 24.2<br>39 | 24.7<br>46 | 24.7<br>55 | 24.4<br>62 |
| 13 | RA<br>DEC | 3 1<br>3 59    | 3.0<br>46  | 2.7<br>44  | 2.2<br>43  | 1.8<br>42  | 1.7<br>44  | 2.1<br>47  | 2.8<br>52  | 3.7<br>57  | 4.6<br>61  | 5.3<br>63  | 5.8<br>62  | 6.0<br>60  | 5.9<br>57  |
| 14 | RA<br>DEC | 3 22<br>49 46  | 38.9<br>47 | 38.4<br>49 | 37.6<br>47 | 36.9<br>43 | 36.7<br>37 | 37.2<br>32 | 38.1<br>30 | 39.4<br>31 | 40.7<br>34 | 41.9<br>40 | 42.7<br>46 | 43.0<br>52 | 42.9<br>57 |
| 15 | RA<br>DEC | 4 34<br>16 27  | 34.7<br>41 | 34.5<br>41 | 34.0<br>40 | 33.4<br>39 | 33.1<br>38 | 33.3<br>39 | 33.8<br>41 | 34.6<br>43 | 35.5<br>46 | 36.4<br>47 | 37.2<br>48 | 37.6<br>47 | 37.8<br>46 |
| 16 | RA<br>DEC | 5 13<br>-8 13  | 25.0<br>50 | 24.9<br>54 | 24.4<br>56 | 23.8<br>56 | 23.4<br>54 | 23.4<br>50 | 23.8<br>44 | 24.4<br>39 | 25.3<br>35 | 26.1<br>35 | 26.9<br>37 | 27.4<br>42 | 27.6<br>48 |
| 17 | RA<br>DEC | 5 14<br>45 58  | 57.9<br>30 | 57.7<br>34 | 57.1<br>35 | 56.3<br>34 | 55.7<br>30 | 55.7<br>26 | 56.3<br>22 | 57.2<br>20 | 58.4<br>19 | 59.7<br>20 | 60.8<br>23 | 61.6<br>27 | 62.0<br>31 |
| 18 | RA<br>DEC | 5 23<br>6 19   | 52.7<br>38 | 52.6<br>36 | 52.2<br>35 | 51.6<br>34 | 51.2<br>35 | 51.2<br>37 | 51.6<br>40 | 52.2<br>44 | 53.1<br>46 | 53.9<br>47 | 54.8<br>45 | 55.3<br>43 | 55.6<br>39 |
| 19 | RA<br>DEC | 5 24<br>28 35  | 48.9<br>15 | 48.8<br>16 | 48.3<br>16 | 47.7<br>16 | 47.3<br>14 | 47.3<br>13 | 47.7<br>12 | 48.4<br>12 | 49.4<br>12 | 50.4<br>13 | 51.3<br>14 | 52.0<br>15 | 52.4<br>16 |

**Table 10a. Apparent Places of Stars, 1976 (Degrees) — Continued**

| STAR<br>NO. | Right<br>ascension<br>Decli-<br>nation | (Hr Min)<br>(° ' ) | Zero hours universal time (GMT) of first day of month |      |      |      |      |      |      |      |      |      |      |      |      |
|-------------|----------------------------------------|--------------------|-------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
|             |                                        |                    | Jan                                                   | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  | Jan  |
|             |                                        |                    | Seconds (time of RA; arc of DEC)                      |      |      |      |      |      |      |      |      |      |      |      |      |
| 20          | RA                                     | 5 35               | 1.8                                                   | 1.7  | 1.3  | 0.7  | 0.3  | 0.2  | 0.6  | 1.2  | 2.0  | 2.8  | 3.6  | 4.3  | 4.6  |
|             | DEC                                    | -1 12              | 66                                                    | 69   | 71   | 71   | 70   | 67   | 63   | 58   | 55   | 55   | 57   | 61   | 66   |
| 21          | RA                                     | 5 39               | 35.0                                                  | 34.9 | 34.5 | 33.9 | 33.5 | 33.4 | 33.7 | 34.3 | 35.1 | 36.0 | 36.8 | 37.4 | 37.7 |
|             | DEC                                    | -1 57              | 23                                                    | 27   | 29   | 29   | 27   | 24   | 20   | 15   | 12   | 12   | 14   | 18   | 23   |
| 22          | RA                                     | 5 53               | 54.5                                                  | 54.5 | 54.1 | 53.5 | 53.1 | 53.0 | 53.3 | 53.9 | 54.7 | 55.6 | 56.4 | 57.1 | 57.5 |
|             | DEC                                    | 7 24               | 6                                                     | 4    | 3    | 2    | 3    | 5    | 7    | 10   | 12   | 13   | 11   | 8    | 5    |
| 23          | RA                                     | 6 23               | 27.8                                                  | 27.5 | 26.7 | 25.6 | 24.6 | 24.0 | 23.9 | 24.4 | 25.4 | 26.6 | 27.8 | 28.7 | 29.0 |
|             | DEC                                    | -52 40             | 64                                                    | 74   | 80   | 82   | 79   | 72   | 63   | 53   | 46   | 45   | 48   | 57   | 68   |
| 24          | RA                                     | 6 36               | 21.8                                                  | 22.0 | 21.7 | 21.1 | 20.6 | 20.4 | 20.6 | 21.1 | 21.9 | 22.7 | 23.7 | 24.5 | 25.0 |
|             | DEC                                    | 16 25              | 7                                                     | 6    | 6    | 6    | 6    | 6    | 7    | 8    | 9    | 8    | 6    | 4    | 2    |
| 25          | RA                                     | 6 44               | 7.4                                                   | 7.5  | 7.1  | 6.5  | 6.0  | 5.7  | 5.8  | 6.2  | 6.9  | 7.7  | 8.6  | 9.4  | 9.8  |
|             | DEC                                    | -16 40             | 67                                                    | 74   | 78   | 79   | 78   | 73   | 68   | 61   | 57   | 56   | 59   | 66   | 74   |
| 26          | RA                                     | 6 57               | 43.2                                                  | 43.2 | 42.8 | 42.1 | 41.5 | 41.1 | 41.1 | 41.5 | 42.2 | 43.0 | 44.0 | 44.8 | 45.3 |
|             | DEC                                    | -28 56             | 27                                                    | 35   | 41   | 43   | 42   | 37   | 30   | 22   | 16   | 14   | 17   | 24   | 34   |
| 27          | RA                                     | 7 7                | 27.1                                                  | 27.2 | 26.8 | 26.2 | 25.6 | 25.2 | 25.2 | 25.5 | 26.2 | 27.0 | 28.0 | 28.8 | 29.3 |
|             | DEC                                    | -26 21             | 23                                                    | 31   | 37   | 39   | 38   | 34   | 27   | 19   | 14   | 12   | 15   | 21   | 30   |
| 28          | RA                                     | 7 33               | 6.6                                                   | 6.9  | 6.7  | 6.1  | 5.5  | 5.2  | 5.2  | 5.6  | 6.3  | 7.2  | 8.3  | 9.3  | 10.0 |
|             | DEC                                    | 31 56              | 21                                                    | 22   | 24   | 26   | 27   | 26   | 24   | 21   | 18   | 16   | 13   | 12   | 11   |
| 29          | RA                                     | 7 38               | 5.0                                                   | 5.2  | 5.1  | 4.6  | 4.1  | 3.8  | 3.8  | 4.1  | 4.7  | 5.4  | 6.3  | 7.2  | 7.8  |
|             | DEC                                    | 5 16               | 64                                                    | 61   | 59   | 59   | 59   | 61   | 63   | 65   | 66   | 66   | 63   | 59   | 54   |
| 30          | RA                                     | 7 43               | 53.3                                                  | 53.6 | 53.5 | 52.9 | 52.4 | 52.0 | 52.0 | 52.3 | 53.0 | 53.8 | 54.9 | 55.8 | 56.6 |
|             | DEC                                    | 28 4               | 55                                                    | 56   | 58   | 59   | 60   | 59   | 58   | 56   | 54   | 51   | 48   | 46   | 45   |
| 31          | RA                                     | 8 8                | 50.1                                                  | 50.4 | 50.1 | 49.3 | 48.4 | 47.7 | 47.3 | 47.4 | 47.9 | 48.8 | 50.0 | 51.1 | 51.9 |
|             | DEC                                    | -47 15             | 59                                                    | 70   | 78   | 84   | 85   | 81   | 74   | 65   | 57   | 53   | 54   | 60   | 70   |
| 32          | RA                                     | 8 22               | 4.5                                                   | 4.8  | 4.4  | 3.3  | 2.1  | 1.0  | 0.4  | 0.3  | 0.8  | 1.9  | 3.3  | 4.8  | 5.8  |
|             | DEC                                    | -59 25             | 56                                                    | 68   | 78   | 84   | 86   | 84   | 77   | 67   | 58   | 53   | 53   | 58   | 69   |
| 33          | RA                                     | 9 7                | 9.1                                                   | 9.6  | 9.6  | 9.0  | 8.3  | 7.6  | 7.2  | 7.1  | 7.4  | 8.1  | 9.1  | 10.2 | 11.2 |
|             | DEC                                    | -43 20             | 7                                                     | 18   | 27   | 34   | 37   | 35   | 30   | 22   | 14   | 9    | 8    | 13   | 22   |
| 34          | RA                                     | 9 12               | 60.8                                                  | 61.5 | 61.2 | 59.9 | 58.3 | 56.5 | 55.2 | 54.5 | 54.8 | 56.0 | 57.9 | 60.0 | 61.7 |
|             | DEC                                    | -69 37             | 2                                                     | 14   | 25   | 34   | 38   | 38   | 33   | 24   | 15   | 8    | 5    | 8    | 17   |
| 35          | RA                                     | 9 26               | 26.3                                                  | 26.9 | 27.0 | 26.7 | 26.3 | 25.9 | 25.6 | 25.6 | 25.9 | 26.4 | 27.2 | 28.1 | 29.0 |
|             | DEC                                    | -8 33              | 22                                                    | 29   | 33   | 36   | 36   | 34   | 31   | 27   | 24   | 23   | 26   | 31   | 38   |
| 36          | RA                                     | 10 7               | 7.3                                                   | 8.0  | 8.3  | 8.1  | 7.7  | 7.3  | 7.1  | 7.0  | 7.1  | 7.6  | 8.3  | 9.2  | 10.2 |
|             | DEC                                    | 12 4               | 54                                                    | 50   | 49   | 50   | 51   | 53   | 54   | 55   | 54   | 52   | 47   | 42   | 36   |
| 37          | RA                                     | 11 0               | 25.5                                                  | 26.8 | 27.4 | 27.3 | 26.7 | 25.8 | 25.0 | 24.5 | 24.3 | 24.7 | 25.7 | 27.0 | 28.6 |
|             | DEC                                    | 56 29              | 77                                                    | 79   | 85   | 93   | 99   | 102  | 101  | 96   | 88   | 79   | 69   | 63   | 59   |

**Table 10a. Apparent Places of Stars, 1976 (Degrees) — Continued**

| STAR<br>NO. | Right<br>ascension (Hr Min) |                 | Zero hours universal time (GMT) of first day of month |            |            |            |            |            |            |            |            |            |            |            |            |
|-------------|-----------------------------|-----------------|-------------------------------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
|             |                             |                 | Jan                                                   | Feb        | Mar        | Apr        | May        | Jun        | Jul        | Aug        | Sep        | Oct        | Nov        | Dec        | Jan        |
|             | Declination (° ' )          |                 | Seconds (time of RA; arc of DEC)                      |            |            |            |            |            |            |            |            |            |            |            |            |
| 38          | RA<br>DEC                   | 11 2<br>61 52   | 16.9<br>27                                            | 18.4<br>29 | 19.1<br>35 | 18.9<br>44 | 18.2<br>50 | 17.1<br>53 | 16.2<br>52 | 15.5<br>46 | 15.3<br>38 | 15.7<br>28 | 16.7<br>18 | 18.2<br>11 | 20.0<br>8  |
| 39          | RA<br>DEC                   | 11 47<br>14 41  | 51.2<br>70                                            | 52.1<br>66 | 52.6<br>64 | 52.8<br>66 | 52.6<br>69 | 52.3<br>72 | 52.0<br>74 | 51.6<br>74 | 51.5<br>73 | 51.6<br>70 | 52.1<br>65 | 52.9<br>58 | 53.9<br>52 |
| 40          | RA<br>DEC                   | 11 52<br>53 49  | 35.1<br>19                                            | 36.5<br>18 | 37.3<br>23 | 37.5<br>31 | 37.1<br>38 | 36.4<br>43 | 35.6<br>44 | 34.9<br>40 | 34.6<br>33 | 34.6<br>24 | 35.3<br>14 | 36.4<br>6  | 37.8<br>0  |
| 41          | RA<br>DEC                   | 12 14<br>-17 24 | 35.2<br>32                                            | 36.2<br>39 | 36.8<br>45 | 37.0<br>49 | 37.0<br>52 | 36.7<br>52 | 36.4<br>50 | 36.0<br>47 | 35.8<br>44 | 35.9<br>42 | 36.3<br>41 | 37.1<br>44 | 38.1<br>50 |
| 42          | RA<br>DEC                   | 12 25<br>-62 57 | 17.0<br>45                                            | 18.7<br>52 | 19.8<br>62 | 20.3<br>72 | 20.1<br>81 | 19.4<br>87 | 18.4<br>89 | 17.4<br>86 | 16.6<br>80 | 16.5<br>72 | 17.1<br>64 | 18.5<br>61 | 20.4<br>63 |
| 43          | RA<br>DEC                   | 12 29<br>-56 58 | 51.1<br>32                                            | 52.6<br>40 | 53.6<br>49 | 54.0<br>59 | 53.9<br>67 | 53.4<br>73 | 52.6<br>74 | 51.8<br>71 | 51.2<br>65 | 51.0<br>57 | 51.6<br>51 | 52.8<br>48 | 54.4<br>50 |
| 44          | RA<br>DEC                   | 12 46<br>-59 33 | 20.0<br>15                                            | 21.6<br>21 | 22.7<br>30 | 23.3<br>40 | 23.3<br>49 | 22.8<br>55 | 22.0<br>58 | 21.0<br>55 | 20.3<br>49 | 20.1<br>42 | 20.6<br>34 | 21.8<br>31 | 23.5<br>32 |
| 45          | RA<br>DEC                   | 12 52<br>56 4   | 58.5<br>62                                            | 60.0<br>60 | 61.0<br>63 | 61.5<br>71 | 61.4<br>79 | 60.8<br>86 | 60.0<br>89 | 59.1<br>87 | 58.4<br>81 | 58.1<br>72 | 58.4<br>62 | 59.3<br>52 | 60.7<br>45 |
| 46          | RA<br>DEC                   | 13 22<br>55 2   | 57.2<br>41                                            | 58.7<br>38 | 59.8<br>40 | 60.4<br>47 | 60.4<br>56 | 60.0<br>63 | 59.2<br>67 | 58.3<br>67 | 57.5<br>62 | 57.1<br>54 | 57.3<br>43 | 58.0<br>33 | 59.3<br>25 |
| 47          | RA<br>DEC                   | 13 23<br>-11 2  | 56.2<br>12                                            | 57.2<br>18 | 57.9<br>22 | 58.4<br>25 | 58.5<br>27 | 58.5<br>26 | 58.2<br>25 | 57.8<br>23 | 57.5<br>20 | 57.3<br>19 | 57.5<br>20 | 58.1<br>23 | 59.1<br>28 |
| 48          | RA<br>DEC                   | 13 46<br>49 25  | 35.3<br>40                                            | 36.6<br>35 | 37.6<br>37 | 38.3<br>43 | 38.4<br>51 | 38.1<br>59 | 37.6<br>63 | 36.8<br>64 | 36.0<br>61 | 35.6<br>52 | 35.6<br>43 | 36.2<br>33 | 37.3<br>24 |
| 49          | RA<br>DEC                   | 14 2<br>-60 15  | 7.8<br>14                                             | 9.5<br>18  | 11.0<br>24 | 12.0<br>33 | 12.5<br>41 | 12.4<br>49 | 11.8<br>53 | 10.9<br>54 | 9.9<br>50  | 9.3<br>43  | 9.4<br>36  | 10.3<br>30 | 11.9<br>29 |
| 50          | RA<br>DEC                   | 14 5<br>-36 15  | 16.4<br>0                                             | 17.6<br>5  | 18.6<br>11 | 19.3<br>17 | 19.6<br>23 | 19.6<br>27 | 19.4<br>28 | 18.9<br>27 | 18.3<br>24 | 18.0<br>20 | 18.1<br>16 | 18.7<br>14 | 19.7<br>16 |
| 51          | RA<br>DEC                   | 14 14<br>19 18  | 33.9<br>16                                            | 35.0<br>10 | 35.8<br>8  | 36.4<br>9  | 36.6<br>14 | 36.6<br>19 | 36.4<br>23 | 35.9<br>25 | 35.5<br>25 | 35.1<br>21 | 35.1<br>15 | 35.6<br>8  | 36.4<br>0  |
| 52          | RA<br>DEC                   | 14 37<br>-60 43 | 58.7<br>51                                            | 60.4<br>53 | 62.0<br>58 | 63.1<br>66 | 63.7<br>74 | 63.8<br>81 | 63.3<br>86 | 62.3<br>88 | 61.3<br>85 | 60.5<br>79 | 60.4<br>71 | 61.1<br>65 | 62.6<br>63 |
| 53          | RA<br>DEC                   | 14 49<br>-15 56 | 33.0<br>31                                            | 34.0<br>35 | 34.9<br>40 | 35.6<br>43 | 36.1<br>44 | 36.2<br>44 | 36.1<br>44 | 35.8<br>42 | 35.3<br>40 | 34.9<br>39 | 34.9<br>38 | 35.3<br>39 | 36.1<br>43 |
| 54          | RA<br>DEC                   | 14 50<br>74 14  | 41.5<br>57                                            | 44.0<br>51 | 46.5<br>52 | 48.4<br>59 | 49.0<br>68 | 48.4<br>78 | 46.9<br>84 | 44.6<br>86 | 42.2<br>83 | 40.3<br>76 | 39.2<br>65 | 39.5<br>54 | 41.1<br>44 |
| 55          | RA<br>DEC                   | 15 33<br>26 47  | 39.7<br>35                                            | 40.6<br>28 | 41.6<br>25 | 42.4<br>27 | 42.9<br>33 | 43.1<br>40 | 43.0<br>46 | 42.6<br>50 | 42.0<br>51 | 41.4<br>48 | 41.2<br>42 | 41.3<br>34 | 42.0<br>26 |

Table 10a. Apparent Places of Stars, 1976 (Degrees) — Continued

| STAR<br>NO. | Right<br>ascension<br><br>Decli-<br>nation | (Hr Min)<br><br>( ° ' ) | Zero hours universal time (GMT) of first day of month |      |      |      |      |      |      |      |      |      |      |      |
|-------------|--------------------------------------------|-------------------------|-------------------------------------------------------|------|------|------|------|------|------|------|------|------|------|------|
|             |                                            |                         | Jan                                                   | Feb  | Mar  | Apr  | May  | Jun  | Jul  | Aug  | Sep  | Oct  | Nov  | Dec  |
|             |                                            |                         | Seconds (time of RA; arc of DEC)                      |      |      |      |      |      |      |      |      |      |      |      |
| 56          | RA                                         | 15 58                   | 54.5                                                  | 55.5 | 56.5 | 57.3 | 58.0 | 58.4 | 58.5 | 58.2 | 57.7 | 57.2 | 56.9 | 57.1 |
|             | DEC                                        | -22 33                  | 10                                                    | 12   | 15   | 18   | 19   | 20   | 21   | 20   | 19   | 18   | 16   | 16   |
| 57          | RA                                         | 16 27                   | 55.7                                                  | 56.7 | 57.7 | 58.6 | 59.4 | 59.9 | 60.0 | 59.8 | 59.3 | 58.8 | 58.4 | 58.5 |
|             | DEC                                        | -26 22                  | 40                                                    | 42   | 44   | 47   | 48   | 49   | 50   | 51   | 50   | 49   | 47   | 46   |
| 58          | RA                                         | 16 46                   | 5.3                                                   | 7.3  | 9.5  | 11.8 | 13.6 | 14.8 | 15.1 | 14.3 | 12.9 | 11.4 | 10.3 | 10.2 |
|             | DEC                                        | -68 58                  | 56                                                    | 52   | 51   | 54   | 59   | 67   | 74   | 80   | 83   | 81   | 75   | 67   |
| 59          | RA                                         | 17 8                    | 59.6                                                  | 60.4 | 61.3 | 62.2 | 62.9 | 63.5 | 63.8 | 63.7 | 63.2 | 62.7 | 62.3 | 62.3 |
|             | DEC                                        | -15 41                  | 42                                                    | 44   | 46   | 47   | 46   | 45   | 44   | 43   | 42   | 42   | 42   | 42   |
| 60          | RA                                         | 17 31                   | 58.1                                                  | 59.0 | 60.0 | 61.1 | 62.1 | 62.9 | 63.2 | 63.2 | 62.7 | 62.0 | 61.5 | 61.4 |
|             | DEC                                        | -37 5                   | 8                                                     | 6    | 6    | 7    | 8    | 10   | 12   | 15   | 16   | 16   | 14   | 11   |
| 61          | RA                                         | 17 33                   | 48.5                                                  | 49.2 | 50.0 | 50.9 | 51.6 | 52.2 | 52.5 | 52.4 | 51.9 | 51.4 | 50.9 | 50.7 |
|             | DEC                                        | 12 34                   | 39                                                    | 32   | 29   | 28   | 32   | 38   | 43   | 49   | 52   | 52   | 49   | 45   |
| 62          | RA                                         | 17 56                   | 1.0                                                   | 1.7  | 2.7  | 3.9  | 5.0  | 5.7  | 6.0  | 5.6  | 4.8  | 3.8  | 2.8  | 2.7  |
|             | DEC                                        | 51 29                   | 31                                                    | 21   | 15   | 15   | 20   | 29   | 39   | 48   | 54   | 55   | 51   | 43   |
| 63          | RA                                         | 18 22                   | 34.1                                                  | 34.8 | 35.7 | 36.8 | 37.8 | 38.7 | 39.2 | 39.3 | 38.9 | 38.3 | 37.7 | 37.5 |
|             | DEC                                        | -34 23                  | 44                                                    | 42   | 41   | 40   | 40   | 40   | 41   | 44   | 45   | 46   | 45   | 43   |
| 64          | RA                                         | 18 36                   | 6.3                                                   | 6.8  | 7.6  | 8.6  | 9.6  | 10.3 | 10.7 | 10.7 | 10.2 | 9.4  | 8.7  | 8.2  |
|             | DEC                                        | 38 45                   | 44                                                    | 35   | 29   | 27   | 31   | 40   | 49   | 58   | 64   | 66   | 64   | 58   |
| 65          | RA                                         | 18 53                   | 46.0                                                  | 46.6 | 47.4 | 48.3 | 49.3 | 50.2 | 50.8 | 50.9 | 50.7 | 50.2 | 49.6 | 49.3 |
|             | DEC                                        | -26 19                  | 35                                                    | 34   | 33   | 31   | 29   | 28   | 28   | 28   | 29   | 30   | 30   | 30   |
| 66          | RA                                         | 19 49                   | 36.2                                                  | 36.5 | 37.0 | 37.8 | 38.6 | 39.5 | 40.1 | 40.4 | 40.3 | 39.8 | 39.3 | 38.9 |
|             | DEC                                        | 8 48                    | 22                                                    | 17   | 14   | 14   | 16   | 22   | 28   | 34   | 38   | 40   | 40   | 37   |
| 67          | RA                                         | 20 23                   | 44.1                                                  | 44.4 | 45.2 | 46.4 | 47.9 | 49.4 | 50.7 | 51.3 | 51.2 | 50.5 | 49.5 | 48.7 |
|             | DEC                                        | -56 48                  | 48                                                    | 41   | 34   | 28   | 24   | 23   | 25   | 20   | 36   | 41   | 43   | 41   |
| 68          | RA                                         | 20 40                   | 35.9                                                  | 35.9 | 36.3 | 37.1 | 38.2 | 39.3 | 40.2 | 40.6 | 40.4 | 39.9 | 39.1 | 38.3 |
|             | DEC                                        | 45 11                   | 54                                                    | 45   | 37   | 32   | 32   | 38   | 47   | 57   | 67   | 73   | 76   | 73   |
| 69          | RA                                         | 21 38                   | 47.7                                                  | 47.0 | 47.7 | 49.7 | 52.7 | 56.2 | 59.3 | 61.3 | 61.8 | 60.6 | 58.1 | 55.3 |
|             | DEC                                        | -77 29                  | 59                                                    | 50   | 40   | 30   | 23   | 20   | 22   | 28   | 37   | 45   | 50   | 49   |
| 70          | RA                                         | 21 43                   | 0.3                                                   | 0.2  | 0.4  | 0.9  | 1.7  | 2.7  | 3.5  | 4.1  | 4.3  | 4.1  | 3.7  | 3.3  |
|             | DEC                                        | 9 45                    | 61                                                    | 57   | 54   | 53   | 55   | 60   | 67   | 73   | 79   | 81   | 82   | 80   |
| 71          | RA                                         | 22 6                    | 43.0                                                  | 42.8 | 43.0 | 43.6 | 44.6 | 45.9 | 47.1 | 48.0 | 48.3 | 48.2 | 47.5 | 46.8 |
|             | DEC                                        | -47 4                   | 45                                                    | 40   | 34   | 26   | 18   | 13   | 11   | 13   | 18   | 24   | 28   | 30   |
| 72          | RA                                         | 22 56                   | 19.6                                                  | 19.4 | 19.4 | 19.7 | 20.4 | 21.4 | 22.4 | 23.3 | 23.7 | 23.8 | 23.5 | 23.0 |
|             | DEC                                        | -29 44                  | 63                                                    | 61   | 57   | 51   | 44   | 37   | 33   | 31   | 33   | 36   | 41   | 44   |
| 73          | RA                                         | 23 3                    | 34.2                                                  | 33.9 | 33.9 | 34.2 | 34.8 | 35.7 | 36.6 | 37.4 | 37.8 | 37.9 | 37.7 | 37.3 |
|             | DEC                                        | 15 4                    | 44                                                    | 40   | 36   | 34   | 35   | 39   | 46   | 52   | 59   | 63   | 65   | 64   |

**Table 10b. Apparent Places of Stars, 1976 (Mils of Declination)**

| STAR<br>NO. | Right<br>ascension<br><br>Decli-<br>nation | (Hr Min)<br><br>(Mils) | Zero hours universal time (GMT) of first day of month |              |              |              |              |              |              |              |              |              |              |              |              |
|-------------|--------------------------------------------|------------------------|-------------------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|             |                                            |                        | Jan                                                   | Feb          | Mar          | Apr          | May          | Jun          | Jul          | Aug          | Sep          | Oct          | Nov          | Dec          | Jan          |
|             |                                            |                        | Seconds of time of RA; mils of DEC                    |              |              |              |              |              |              |              |              |              |              |              |              |
| 1           | RA<br>DEC                                  | 0 7<br>514             | 9.5<br>0.88                                           | 9.0<br>0.86  | 8.8<br>0.84  | 8.9<br>0.81  | 9.4<br>0.80  | 10.3<br>0.81 | 11.3<br>0.84 | 12.2<br>0.87 | 12.9<br>0.91 | 13.2<br>0.94 | 13.1<br>0.96 | 12.8<br>0.97 | 12.3<br>0.97 |
| 2           | RA<br>DEC                                  | 0 7<br>1049            | 54.5<br>0.31                                          | 53.6<br>0.29 | 53.0<br>0.25 | 53.0<br>0.21 | 53.8<br>0.18 | 55.2<br>0.17 | 56.7<br>0.19 | 58.1<br>0.22 | 59.1<br>0.27 | 59.5<br>0.32 | 59.2<br>0.37 | 58.6<br>0.39 | 57.6<br>0.40 |
| 3           | RA<br>DEC                                  | 0 24<br>-1375          | 29.2<br>0.89                                          | 26.7<br>0.86 | 25.1<br>0.82 | 24.7<br>0.76 | 25.7<br>0.71 | 28.0<br>0.67 | 31.0<br>0.64 | 34.2<br>0.65 | 36.5<br>0.67 | 37.3<br>0.72 | 36.5<br>0.76 | 34.3<br>0.79 | 31.5<br>0.80 |
| 4           | RA<br>DEC                                  | 0 25<br>-754           | 6.4<br>0.47                                           | 5.8<br>0.46  | 5.4<br>0.44  | 5.4<br>0.40  | 5.8<br>0.36  | 6.7<br>0.31  | 7.8<br>0.28  | 8.9<br>0.27  | 9.7<br>0.28  | 10.1<br>0.31 | 10.0<br>0.34 | 9.5<br>0.37  | 8.9<br>0.39  |
| 5           | RA<br>DEC                                  | 0 39<br>1002           | 9.7<br>0.88                                           | 8.8<br>0.86  | 8.2<br>0.83  | 8.1<br>0.79  | 8.6<br>0.76  | 9.8<br>0.75  | 11.3<br>0.76 | 12.7<br>0.79 | 13.8<br>0.83 | 14.3<br>0.88 | 14.3<br>0.92 | 13.8<br>0.95 | 13.0<br>0.96 |
| 6           | RA<br>DEC                                  | 0 42<br>-321           | 23.8<br>1.12                                          | 23.4<br>1.12 | 23.1<br>1.11 | 23.1<br>1.10 | 23.4<br>1.07 | 24.1<br>1.03 | 25.1<br>1.00 | 26.0<br>0.98 | 26.7<br>0.97 | 27.1<br>0.98 | 27.1<br>1.00 | 26.9<br>1.02 | 26.5<br>1.03 |
| 7           | RA<br>DEC                                  | 0 55<br>1077           | 16.8<br>0.21                                          | 15.7<br>0.20 | 14.9<br>0.17 | 14.7<br>0.13 | 15.2<br>0.09 | 16.5<br>0.08 | 18.1<br>0.08 | 19.7<br>0.11 | 20.9<br>0.15 | 21.6<br>0.20 | 21.7<br>0.25 | 21.2<br>0.28 | 20.3<br>0.29 |
| 8           | RA<br>DEC                                  | 1 24<br>1068           | 16.3<br>0.74                                          | 15.2<br>0.73 | 14.4<br>0.71 | 14.0<br>0.67 | 14.3<br>0.63 | 15.5<br>0.61 | 17.0<br>0.61 | 18.6<br>0.64 | 20.0<br>0.67 | 20.8<br>0.72 | 21.1<br>0.77 | 20.8<br>0.80 | 20.0<br>0.82 |
| 9           | RA<br>DEC                                  | 1 36<br>-1019          | 50.0<br>0.78                                          | 49.0<br>0.78 | 48.1<br>0.75 | 47.6<br>0.71 | 47.7<br>0.66 | 48.4<br>0.61 | 49.6<br>0.57 | 51.0<br>0.55 | 52.3<br>0.56 | 53.0<br>0.59 | 53.2<br>0.64 | 52.7<br>0.68 | 51.8<br>0.70 |

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**See Table 11. Apparent Places of Polaris, 1976**

|    |           |              |              |              |              |              |              |              |              |              |              |              |              |              |              |
|----|-----------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| 11 | RA<br>DEC | 2 5<br>415   | 50.6<br>0.14 | 50.2<br>0.13 | 49.7<br>0.12 | 49.4<br>0.11 | 49.6<br>0.10 | 50.2<br>0.10 | 51.0<br>0.12 | 52.0<br>0.14 | 52.9<br>0.17 | 53.6<br>0.19 | 53.9<br>0.20 | 54.0<br>0.21 | 53.7<br>0.21 |
| 12 | RA<br>DEC | 2 57<br>-718 | 22.4<br>0.29 | 21.8<br>0.31 | 21.1<br>0.30 | 20.5<br>0.28 | 20.3<br>0.24 | 20.6<br>0.19 | 21.3<br>0.14 | 22.4<br>0.11 | 23.4<br>0.10 | 24.2<br>0.12 | 24.7<br>0.16 | 24.7<br>0.20 | 24.4<br>0.23 |
| 13 | RA<br>DEC | 3 1<br>71    | 3.0<br>0.04  | 2.7<br>0.03  | 2.2<br>0.03  | 1.8<br>0.02  | 1.7<br>0.03  | 2.1<br>0.05  | 2.8<br>0.07  | 3.7<br>0.10  | 4.6<br>0.12  | 5.3<br>0.12  | 5.8<br>0.12  | 6.0<br>0.11  | 5.9<br>0.10  |
| 14 | RA<br>DEC | 3 22<br>884  | 38.9<br>0.97 | 38.4<br>0.98 | 37.6<br>0.97 | 36.9<br>0.95 | 36.7<br>0.92 | 37.2<br>0.90 | 38.1<br>0.89 | 39.4<br>0.89 | 40.7<br>0.91 | 41.9<br>0.94 | 42.7<br>0.97 | 43.0<br>1.00 | 42.9<br>1.02 |
| 15 | RA<br>DEC | 4 34<br>292  | 34.7<br>0.65 | 34.5<br>0.64 | 34.0<br>0.64 | 33.4<br>0.64 | 33.1<br>0.63 | 33.3<br>0.64 | 33.8<br>0.64 | 34.6<br>0.66 | 35.5<br>0.67 | 36.4<br>0.68 | 37.2<br>0.68 | 37.6<br>0.68 | 37.8<br>0.67 |
| 16 | RA<br>DEC | 5 13<br>-146 | 25.0<br>0.32 | 24.9<br>0.34 | 24.4<br>0.35 | 23.8<br>0.35 | 23.4<br>0.34 | 23.4<br>0.32 | 23.8<br>0.29 | 24.4<br>0.27 | 25.3<br>0.25 | 26.1<br>0.25 | 26.9<br>0.26 | 27.4<br>0.28 | 27.6<br>0.31 |
| 17 | RA<br>DEC | 5 14<br>817  | 57.9<br>0.33 | 57.7<br>0.35 | 57.1<br>0.36 | 56.3<br>0.35 | 55.7<br>0.33 | 55.7<br>0.31 | 56.3<br>0.29 | 57.2<br>0.28 | 58.4<br>0.28 | 59.7<br>0.29 | 60.8<br>0.30 | 61.6<br>0.32 | 62.0<br>0.34 |
| 18 | RA<br>DEC | 5 23<br>112  | 52.7<br>0.49 | 52.6<br>0.47 | 52.2<br>0.47 | 51.6<br>0.47 | 51.2<br>0.47 | 51.2<br>0.48 | 51.6<br>0.49 | 52.2<br>0.51 | 53.1<br>0.52 | 53.9<br>0.53 | 54.8<br>0.52 | 55.3<br>0.51 | 55.6<br>0.49 |
| 19 | RA<br>DEC | 5 24<br>508  | 48.9<br>0.22 | 48.8<br>0.23 | 48.3<br>0.23 | 47.7<br>0.23 | 47.3<br>0.22 | 47.3<br>0.21 | 47.7<br>0.21 | 48.4<br>0.21 | 49.4<br>0.21 | 50.4<br>0.21 | 51.3<br>0.22 | 52.0<br>0.22 | 52.4<br>0.23 |

**Table 10b. Apparent Places of Stars, 1976 (Mils of Declination) — Continued**

| STAR<br>NO. | Right<br>ascension<br><br>Decli-<br>nation | (Hr Min)<br><br>(Mils) | Zero hours universal time (GMT) of first day of month |              |              |              |              |              |              |              |              |              |              |              |              |
|-------------|--------------------------------------------|------------------------|-------------------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|             |                                            |                        | Jan                                                   | Feb          | Mar          | Apr          | May          | Jun          | Jul          | Aug          | Sep          | Oct          | Nov          | Dec          | Jan          |
|             |                                            |                        | Seconds of time of RA; mils of DEC                    |              |              |              |              |              |              |              |              |              |              |              |              |
| 20          | RA<br>DEC                                  | 5 35<br>-21            | 1.8<br>0.66                                           | 1.7<br>0.68  | 1.3<br>0.68  | 0.7<br>0.69  | 0.3<br>0.68  | 0.2<br>0.66  | 0.6<br>0.64  | 1.2<br>0.62  | 2.0<br>0.61  | 2.8<br>0.60  | 3.6<br>0.61  | 4.3<br>0.63  | 4.6<br>0.66  |
| 21          | RA<br>DEC                                  | 5 39<br>-34            | 35.0<br>0.78                                          | 34.9<br>0.80 | 34.5<br>0.81 | 33.9<br>0.81 | 33.5<br>0.80 | 33.4<br>0.79 | 33.7<br>0.76 | 34.3<br>0.74 | 35.1<br>0.73 | 36.0<br>0.73 | 36.8<br>0.74 | 37.4<br>0.76 | 37.7<br>0.78 |
| 22          | RA<br>DEC                                  | 5 53<br>131            | 54.5<br>0.59                                          | 54.5<br>0.58 | 54.1<br>0.57 | 53.5<br>0.57 | 53.1<br>0.57 | 53.0<br>0.58 | 53.3<br>0.59 | 53.9<br>0.61 | 54.7<br>0.62 | 55.6<br>0.62 | 56.4<br>0.61 | 57.1<br>0.60 | 57.5<br>0.58 |
| 23          | RA<br>DEC                                  | 6 23<br>-936           | 27.8<br>0.61                                          | 27.5<br>0.66 | 26.7<br>0.69 | 25.6<br>0.70 | 24.6<br>0.69 | 24.0<br>0.65 | 23.9<br>0.61 | 24.4<br>0.56 | 25.4<br>0.53 | 26.6<br>0.52 | 27.8<br>0.54 | 28.7<br>0.58 | 29.0<br>0.63 |
| 24          | RA<br>DEC                                  | 6 36<br>291            | 21.8<br>0.89                                          | 22.0<br>0.88 | 21.7<br>0.88 | 21.1<br>0.88 | 20.6<br>0.88 | 20.4<br>0.88 | 20.6<br>0.89 | 21.1<br>0.89 | 21.9<br>0.89 | 22.7<br>0.89 | 23.7<br>0.88 | 24.5<br>0.87 | 25.0<br>0.86 |
| 25          | RA<br>DEC                                  | 6 44<br>-296           | 7.4<br>0.63                                           | 7.5<br>0.66  | 7.1<br>0.68  | 6.5<br>0.69  | 6.0<br>0.68  | 5.7<br>0.66  | 5.8<br>0.63  | 6.2<br>0.60  | 6.9<br>0.58  | 7.7<br>0.57  | 8.6<br>0.59  | 9.4<br>0.62  | 9.8<br>0.66  |
| 26          | RA<br>DEC                                  | 6 57<br>-514           | 43.2<br>0.50                                          | 43.2<br>0.55 | 42.8<br>0.57 | 42.1<br>0.58 | 41.5<br>0.58 | 41.1<br>0.55 | 41.1<br>0.52 | 41.5<br>0.48 | 42.2<br>0.45 | 43.0<br>0.44 | 44.0<br>0.46 | 44.8<br>0.49 | 45.3<br>0.54 |
| 27          | RA<br>DEC                                  | 7 7<br>-468            | 27.1<br>0.56                                          | 27.2<br>0.60 | 26.8<br>0.63 | 26.2<br>0.64 | 25.6<br>0.63 | 25.2<br>0.61 | 25.2<br>0.58 | 25.5<br>0.54 | 26.2<br>0.51 | 27.0<br>0.50 | 28.0<br>0.52 | 28.8<br>0.55 | 29.3<br>0.59 |
| 28          | RA<br>DEC                                  | 7 33<br>567            | 6.6<br>0.81                                           | 6.9<br>0.81  | 6.7<br>0.82  | 6.1<br>0.83  | 5.5<br>0.84  | 5.2<br>0.83  | 5.2<br>0.82  | 5.6<br>0.81  | 6.3<br>0.79  | 7.2<br>0.78  | 8.3<br>0.77  | 9.3<br>0.76  | 10.0<br>0.76 |
| 29          | RA<br>DEC                                  | 7 38<br>93             | 5.0<br>0.95                                           | 5.2<br>0.93  | 5.1<br>0.92  | 4.6<br>0.92  | 4.1<br>0.92  | 3.8<br>0.93  | 3.8<br>0.94  | 4.1<br>0.95  | 4.7<br>0.96  | 5.4<br>0.95  | 6.3<br>0.94  | 7.2<br>0.92  | 7.8<br>0.90  |
| 30          | RA<br>DEC                                  | 7 43<br>499            | 53.3<br>0.23                                          | 53.6<br>0.24 | 53.5<br>0.25 | 52.9<br>0.26 | 52.4<br>0.26 | 52.0<br>0.26 | 52.0<br>0.25 | 52.3<br>0.24 | 53.0<br>0.23 | 53.8<br>0.22 | 54.9<br>0.20 | 55.8<br>0.19 | 56.6<br>0.19 |
| 31          | RA<br>DEC                                  | 8 8<br>-840            | 50.1<br>0.29                                          | 50.4<br>0.34 | 50.1<br>0.39 | 49.3<br>0.41 | 48.4<br>0.42 | 47.7<br>0.40 | 47.3<br>0.37 | 47.4<br>0.32 | 47.9<br>0.28 | 48.8<br>0.26 | 50.0<br>0.27 | 51.1<br>0.30 | 51.9<br>0.35 |
| 32          | RA<br>DEC                                  | 8 22<br>-1056          | 4.5<br>0.57                                           | 4.8<br>0.63  | 4.4<br>0.68  | 3.3<br>0.71  | 2.1<br>0.72  | 1.0<br>0.71  | 0.4<br>0.68  | 0.3<br>0.63  | 0.8<br>0.59  | 1.9<br>0.56  | 3.3<br>0.56  | 4.8<br>0.58  | 5.8<br>0.63  |
| 33          | RA<br>DEC                                  | 9 7<br>-770            | 9.1<br>0.41                                           | 9.6<br>0.46  | 9.6<br>0.50  | 9.0<br>0.54  | 8.3<br>0.55  | 7.6<br>0.54  | 7.2<br>0.52  | 7.1<br>0.48  | 7.4<br>0.44  | 8.1<br>0.41  | 9.1<br>0.41  | 10.2<br>0.43 | 11.2<br>0.48 |
| 34          | RA<br>DEC                                  | 9 12<br>-1237          | 60.8<br>0.64                                          | 61.5<br>0.70 | 61.2<br>0.75 | 59.9<br>0.80 | 58.3<br>0.82 | 56.5<br>0.82 | 55.2<br>0.79 | 54.5<br>0.75 | 54.8<br>0.70 | 56.0<br>0.67 | 57.9<br>0.65 | 60.0<br>0.67 | 61.7<br>0.72 |
| 35          | RA<br>DEC                                  | 9 26<br>-152           | 26.3<br>0.11                                          | 26.9<br>0.14 | 27.0<br>0.16 | 26.7<br>0.18 | 26.3<br>0.18 | 25.9<br>0.17 | 25.6<br>0.15 | 25.6<br>0.13 | 25.9<br>0.12 | 26.4<br>0.12 | 27.2<br>0.13 | 28.1<br>0.15 | 29.0<br>0.19 |
| 36          | RA<br>DEC                                  | 10 7<br>214            | 7.3<br>0.78                                           | 8.0<br>0.76  | 8.3<br>0.76  | 8.1<br>0.76  | 7.7<br>0.77  | 7.3<br>0.78  | 7.1<br>0.79  | 7.0<br>0.79  | 7.1<br>0.79  | 7.6<br>0.77  | 8.3<br>0.75  | 9.2<br>0.73  | 10.2<br>0.70 |
| 37          | RA<br>DEC                                  | 11 0<br>1004           | 25.5<br>0.53                                          | 26.8<br>0.54 | 27.4<br>0.57 | 27.3<br>0.61 | 26.7<br>0.64 | 25.8<br>0.65 | 25.0<br>0.65 | 24.5<br>0.62 | 24.3<br>0.58 | 24.7<br>0.54 | 25.7<br>0.49 | 27.0<br>0.46 | 28.6<br>0.44 |



**Table 10b. Apparent Places of Stars, 1976 (Mils of Declination) — Continued**

| STAR<br>NO. | Right<br>ascension<br><br>Decli-<br>nation | (Hr Min)<br><br>(Mils) | Zero hours universal time (GMT) of first day of month |              |              |              |              |              |              |              |              |              |              |              |              |
|-------------|--------------------------------------------|------------------------|-------------------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|             |                                            |                        | Jan                                                   | Feb          | Mar          | Apr          | May          | Jun          | Jul          | Aug          | Sep          | Oct          | Nov          | Dec          | Jan          |
|             |                                            |                        | Seconds of time of RA; mils of DEC                    |              |              |              |              |              |              |              |              |              |              |              |              |
| 38          | RA<br>DEC                                  | 11 2<br>1099           | 16.9<br>0.98                                          | 18.4<br>1.00 | 19.1<br>1.03 | 18.9<br>1.07 | 18.2<br>1.10 | 17.1<br>1.12 | 16.2<br>1.11 | 15.5<br>1.08 | 15.3<br>1.04 | 15.7<br>0.99 | 16.7<br>0.94 | 18.2<br>0.91 | 20.0<br>0.89 |
| 39          | RA<br>DEC                                  | 11 47<br>261           | 51.2<br>0.38                                          | 52.1<br>0.36 | 52.6<br>0.36 | 52.8<br>0.36 | 52.6<br>0.38 | 52.3<br>0.39 | 52.0<br>0.40 | 51.6<br>0.40 | 51.5<br>0.40 | 51.6<br>0.38 | 52.1<br>0.36 | 52.9<br>0.32 | 53.9<br>0.29 |
| 40          | RA<br>DEC                                  | 11 52<br>956           | 35.1<br>0.83                                          | 36.5<br>0.83 | 37.3<br>0.85 | 37.5<br>0.89 | 37.1<br>0.93 | 36.4<br>0.95 | 35.6<br>0.96 | 34.9<br>0.94 | 34.6<br>0.91 | 34.6<br>0.86 | 35.3<br>0.81 | 36.4<br>0.77 | 37.8<br>0.74 |
| 41          | RA<br>DEC                                  | 12 14<br>-309          | 35.2<br>0.49                                          | 36.2<br>0.53 | 36.8<br>0.55 | 37.0<br>0.58 | 37.0<br>0.59 | 36.7<br>0.59 | 36.4<br>0.58 | 36.0<br>0.57 | 35.8<br>0.55 | 35.9<br>0.54 | 36.3<br>0.54 | 37.1<br>0.55 | 38.1<br>0.58 |
| 42          | RA<br>DEC                                  | 12 25<br>-1119         | 17.0<br>0.33                                          | 18.7<br>0.37 | 19.8<br>0.42 | 20.3<br>0.47 | 20.1<br>0.51 | 19.4<br>0.54 | 18.4<br>0.55 | 17.4<br>0.54 | 16.6<br>0.51 | 16.5<br>0.46 | 17.1<br>0.43 | 18.5<br>0.41 | 20.4<br>0.42 |
| 43          | RA<br>DEC                                  | 12 29<br>-1012         | 51.1<br>0.90                                          | 52.6<br>0.94 | 53.6<br>0.98 | 54.0<br>1.03 | 53.9<br>1.07 | 53.4<br>1.10 | 52.6<br>1.11 | 51.8<br>1.09 | 51.2<br>1.06 | 51.0<br>1.02 | 51.6<br>0.99 | 52.8<br>0.98 | 54.4<br>0.99 |
| 44          | RA<br>DEC                                  | 12 46<br>-1058         | 20.0<br>0.74                                          | 21.6<br>0.77 | 22.7<br>0.82 | 23.3<br>0.87 | 23.3<br>0.91 | 22.8<br>0.94 | 22.0<br>0.95 | 21.0<br>0.94 | 20.3<br>0.91 | 20.1<br>0.87 | 20.6<br>0.84 | 21.8<br>0.82 | 23.5<br>0.83 |
| 45          | RA<br>DEC                                  | 12 52<br>996           | 58.5<br>1.05                                          | 60.0<br>1.04 | 61.0<br>1.05 | 61.5<br>1.09 | 61.4<br>1.13 | 60.8<br>1.16 | 60.0<br>1.18 | 59.1<br>1.17 | 58.4<br>1.14 | 58.1<br>1.10 | 58.4<br>1.04 | 59.3<br>1.00 | 60.7<br>0.96 |
| 46          | RA<br>DEC                                  | 13 22<br>978           | 57.2<br>0.57                                          | 58.7<br>0.56 | 59.8<br>0.57 | 60.4<br>0.60 | 60.4<br>0.65 | 60.0<br>0.68 | 59.2<br>0.70 | 58.3<br>0.70 | 57.5<br>0.68 | 57.1<br>0.64 | 57.3<br>0.58 | 58.0<br>0.53 | 59.3<br>0.49 |
| 47          | RA<br>DEC                                  | 13 23<br>-196          | 56.2<br>0.21                                          | 57.2<br>0.24 | 57.9<br>0.26 | 58.4<br>0.27 | 58.5<br>0.28 | 58.5<br>0.28 | 58.2<br>0.27 | 57.8<br>0.26 | 57.5<br>0.25 | 57.3<br>0.24 | 57.5<br>0.25 | 58.1<br>0.26 | 59.1<br>0.29 |
| 48          | RA<br>DEC                                  | 13 46<br>878           | 35.3<br>0.72                                          | 36.6<br>0.69 | 37.6<br>0.70 | 38.3<br>0.73 | 38.4<br>0.77 | 38.1<br>0.81 | 37.6<br>0.83 | 36.8<br>0.84 | 36.0<br>0.82 | 35.6<br>0.78 | 35.6<br>0.73 | 36.2<br>0.68 | 37.3<br>0.64 |
| 49          | RA<br>DEC                                  | 14 2<br>-1071          | 7.8<br>0.18                                           | 9.5<br>0.20  | 11.0<br>0.23 | 12.0<br>0.27 | 12.5<br>0.32 | 12.4<br>0.35 | 11.8<br>0.37 | 10.9<br>0.38 | 9.9<br>0.36  | 9.3<br>0.33  | 9.4<br>0.29  | 10.3<br>0.26 | 11.9<br>0.25 |
| 50          | RA<br>DEC                                  | 14 5<br>-644           | 16.4<br>0.45                                          | 17.6<br>0.47 | 18.6<br>0.50 | 19.3<br>0.53 | 19.6<br>0.56 | 19.6<br>0.58 | 19.4<br>0.58 | 18.9<br>0.58 | 18.3<br>0.56 | 18.0<br>0.54 | 18.1<br>0.52 | 18.7<br>0.51 | 19.7<br>0.52 |
| 51          | RA<br>DEC                                  | 14 14<br>343           | 33.9<br>0.19                                          | 35.0<br>0.16 | 35.8<br>0.15 | 36.4<br>0.16 | 36.6<br>0.18 | 36.6<br>0.20 | 36.4<br>0.22 | 35.9<br>0.23 | 35.5<br>0.23 | 35.1<br>0.22 | 35.1<br>0.19 | 35.6<br>0.15 | 36.4<br>0.11 |
| 52          | RA<br>DEC                                  | 14 37<br>-1079         | 58.7<br>0.66                                          | 60.4<br>0.67 | 62.0<br>0.69 | 63.1<br>0.73 | 63.7<br>0.77 | 63.8<br>0.81 | 63.3<br>0.83 | 62.3<br>0.84 | 61.3<br>0.83 | 60.5<br>0.80 | 60.4<br>0.76 | 61.1<br>0.73 | 62.6<br>0.72 |
| 53          | RA<br>DEC                                  | 14 49<br>-283          | 33.0<br>0.41                                          | 34.0<br>0.43 | 34.9<br>0.46 | 35.6<br>0.47 | 36.1<br>0.48 | 36.2<br>0.48 | 36.1<br>0.47 | 35.8<br>0.47 | 35.3<br>0.46 | 34.9<br>0.45 | 34.9<br>0.45 | 35.3<br>0.45 | 36.1<br>0.47 |
| 54          | RA<br>DEC                                  | 14 50<br>1319          | 41.5<br>0.98                                          | 44.0<br>0.96 | 46.5<br>0.96 | 48.4<br>0.99 | 49.0<br>1.04 | 48.4<br>1.09 | 46.9<br>1.12 | 44.6<br>1.13 | 42.2<br>1.12 | 40.3<br>1.08 | 39.2<br>1.03 | 39.5<br>0.97 | 41.1<br>0.92 |
| 55          | RA<br>DEC                                  | 15 33<br>476           | 39.7<br>0.32                                          | 40.6<br>0.29 | 41.6<br>0.27 | 42.4<br>0.28 | 42.9<br>0.31 | 43.1<br>0.34 | 43.0<br>0.37 | 42.6<br>0.40 | 42.0<br>0.40 | 41.4<br>0.39 | 41.2<br>0.36 | 41.3<br>0.32 | 42.0<br>0.27 |

**Table 10b. Apparent Places of Stars, 1976 (Mils of Declination) — Continued**

| STAR<br>NO. | Right<br>ascension<br><br>Declination<br><br>(Mils) | (Hr Min)       | Zero hours universal time (GMT) of first day of month |              |              |              |              |              |              |              |              |              |              |              |
|-------------|-----------------------------------------------------|----------------|-------------------------------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
|             |                                                     |                | Jan                                                   | Feb          | Mar          | Apr          | May          | Jun          | Jul          | Aug          | Sep          | Oct          | Nov          | Dec          |
|             |                                                     |                | Seconds of time of RA; mils of DEC                    |              |              |              |              |              |              |              |              |              |              |              |
| 56          | RA<br>DEC                                           | 15 58<br>-400  | 54.5<br>0.94                                          | 55.5<br>0.95 | 56.5<br>0.97 | 57.3<br>0.98 | 58.0<br>0.99 | 58.4<br>0.99 | 58.5<br>0.99 | 58.2<br>0.99 | 57.7<br>0.98 | 57.2<br>0.98 | 56.9<br>0.97 | 57.1<br>0.97 |
| 57          | RA<br>DEC                                           | 16 27<br>-468  | 55.7<br>0.94                                          | 56.7<br>0.95 | 57.7<br>0.96 | 58.6<br>0.97 | 59.4<br>0.98 | 59.9<br>0.98 | 60.0<br>0.99 | 59.8<br>0.99 | 59.3<br>0.99 | 58.8<br>0.98 | 58.4<br>0.97 | 58.5<br>0.97 |
| 58          | RA<br>DEC                                           | 16 46<br>-1226 | 5.3<br>0.35                                           | 7.3<br>0.33  | 9.5<br>0.33  | 11.8<br>0.34 | 13.6<br>0.37 | 14.8<br>0.41 | 15.1<br>0.44 | 14.3<br>0.47 | 12.9<br>0.48 | 11.4<br>0.47 | 10.3<br>0.44 | 10.2<br>0.41 |
| 59          | RA<br>DEC                                           | 17 8<br>-279   | 59.6<br>0.02                                          | 60.4<br>0.03 | 61.3<br>0.04 | 62.2<br>0.05 | 62.9<br>0.04 | 63.5<br>0.04 | 63.8<br>0.03 | 63.7<br>0.03 | 63.2<br>0.02 | 62.7<br>0.02 | 62.3<br>0.02 | 62.3<br>0.02 |
| 60          | RA<br>DEC                                           | 17 31<br>-659  | 58.1<br>0.30                                          | 59.0<br>0.29 | 60.0<br>0.29 | 61.1<br>0.29 | 62.1<br>0.30 | 62.9<br>0.31 | 63.2<br>0.32 | 63.2<br>0.33 | 62.7<br>0.34 | 62.0<br>0.34 | 61.5<br>0.33 | 61.4<br>0.31 |
| 61          | RA<br>DEC                                           | 17 33<br>223   | 48.5<br>0.60                                          | 49.2<br>0.57 | 50.0<br>0.55 | 50.9<br>0.55 | 51.6<br>0.56 | 52.2<br>0.59 | 52.5<br>0.62 | 52.4<br>0.65 | 51.9<br>0.66 | 51.4<br>0.66 | 50.9<br>0.65 | 50.7<br>0.63 |
| 62          | RA<br>DEC                                           | 17 56<br>915   | 1.0<br>0.41                                           | 1.7<br>0.36  | 2.7<br>0.34  | 3.9<br>0.33  | 5.0<br>0.36  | 5.7<br>0.40  | 6.0<br>0.45  | 5.6<br>0.50  | 4.8<br>0.52  | 3.8<br>0.53  | 2.8<br>0.51  | 2.2<br>0.47  |
| 63          | RA<br>DEC                                           | 18 22<br>-611  | 34.1<br>0.48                                          | 34.8<br>0.47 | 35.7<br>0.46 | 36.8<br>0.46 | 37.8<br>0.45 | 38.7<br>0.46 | 39.2<br>0.46 | 39.3<br>0.47 | 38.9<br>0.48 | 38.3<br>0.49 | 37.7<br>0.48 | 37.5<br>0.47 |
| 64          | RA<br>DEC                                           | 18 36<br>689   | 6.3<br>0.11                                           | 6.8<br>0.06  | 7.6<br>0.03  | 8.6<br>0.02  | 9.6<br>0.04  | 10.3<br>0.08 | 10.7<br>0.13 | 10.7<br>0.17 | 10.2<br>0.20 | 9.4<br>0.22  | 8.7<br>0.21  | 8.2<br>0.18  |
| 65          | RA<br>DEC                                           | 18 53<br>-467  | 46.0<br>1.02                                          | 46.6<br>1.02 | 47.4<br>1.01 | 48.3<br>1.01 | 49.3<br>1.00 | 50.2<br>0.99 | 50.8<br>0.99 | 50.9<br>0.99 | 50.7<br>1.00 | 50.2<br>1.00 | 49.6<br>1.00 | 49.3<br>1.00 |
| 66          | RA<br>DEC                                           | 19 49<br>156   | 36.2<br>0.55                                          | 36.5<br>0.53 | 37.0<br>0.51 | 37.8<br>0.51 | 38.6<br>0.53 | 39.5<br>0.55 | 40.1<br>0.58 | 40.4<br>0.61 | 40.3<br>0.63 | 39.8<br>0.64 | 39.3<br>0.64 | 38.9<br>0.63 |
| 67          | RA<br>DEC                                           | 20 23<br>-1009 | 44.1<br>1.02                                          | 44.4<br>0.98 | 45.2<br>0.95 | 46.4<br>0.91 | 47.9<br>0.89 | 49.4<br>0.89 | 50.7<br>0.90 | 51.3<br>0.93 | 51.2<br>0.96 | 50.5<br>0.98 | 49.5<br>0.99 | 48.7<br>0.98 |
| 68          | RA<br>DEC                                           | 20 40<br>803   | 35.9<br>0.52                                          | 35.9<br>0.48 | 36.3<br>0.44 | 37.1<br>0.42 | 38.2<br>0.42 | 39.3<br>0.45 | 40.2<br>0.49 | 40.6<br>0.54 | 40.4<br>0.59 | 39.9<br>0.62 | 39.1<br>0.63 | 38.3<br>0.62 |
| 69          | RA<br>DEC                                           | 21 38<br>-1377 | 47.7<br>0.77                                          | 47.0<br>0.73 | 47.7<br>0.68 | 49.7<br>0.63 | 52.7<br>0.60 | 56.2<br>0.58 | 59.3<br>0.59 | 61.3<br>0.62 | 61.8<br>0.66 | 60.6<br>0.70 | 58.1<br>0.73 | 55.3<br>0.72 |
| 70          | RA<br>DEC                                           | 21 43<br>173   | 0.3<br>0.64                                           | 0.2<br>0.62  | 0.4<br>0.60  | 0.9<br>0.59  | 1.7<br>0.61  | 2.7<br>0.63  | 3.5<br>0.66  | 4.1<br>0.70  | 4.3<br>0.72  | 4.1<br>0.74  | 3.7<br>0.74  | 3.3<br>0.73  |
| 71          | RA<br>DEC                                           | 22 6<br>-836   | 43.0<br>0.97                                          | 42.8<br>0.94 | 43.0<br>0.91 | 43.6<br>0.87 | 44.6<br>0.83 | 45.9<br>0.81 | 47.1<br>0.80 | 48.0<br>0.81 | 48.3<br>0.83 | 48.2<br>0.86 | 47.5<br>0.88 | 46.8<br>0.89 |
| 72          | RA<br>DEC                                           | 22 56<br>-528  | 19.6<br>0.90                                          | 19.4<br>0.89 | 19.4<br>0.87 | 19.7<br>0.84 | 20.4<br>0.81 | 21.4<br>0.78 | 22.4<br>0.75 | 23.3<br>0.75 | 23.7<br>0.75 | 23.8<br>0.77 | 23.5<br>0.79 | 23.0<br>0.81 |
| 73          | RA<br>DEC                                           | 23 3<br>268    | 34.2<br>0.07                                          | 33.9<br>0.05 | 33.9<br>0.03 | 34.2<br>0.02 | 34.8<br>0.02 | 35.7<br>0.05 | 36.6<br>0.08 | 37.4<br>0.11 | 37.8<br>0.14 | 37.9<br>0.16 | 37.7<br>0.17 | 37.3<br>0.17 |

**Table 11. Apparent Place of Polaris (Star No. 10), 1976**  
 Zero hours universal time (GMT) on 0, 10th, 20th, 30th Days of Month

|       | Declination |   |    |         | Right Ascension |    |    |
|-------|-------------|---|----|---------|-----------------|----|----|
|       | °           | ' | "  | m       | h               | m  | s  |
| JAN 0 | 89          | 9 | 36 | 1585.07 | 2               | 9  | 35 |
| 10    |             |   | 38 | 1585.08 |                 |    | 21 |
| 20    |             |   | 39 | 1585.08 |                 |    | 8  |
| 30    |             |   | 39 | 1585.08 |                 | 8  | 54 |
| FEB 0 | 89          | 9 | 39 | 1585.08 | 2               | 8  | 52 |
| 10    |             |   | 39 | 1585.08 |                 |    | 37 |
| 20    |             |   | 38 | 1585.08 |                 |    | 23 |
| 30    |             |   | 36 | 1585.07 |                 |    | 11 |
| MAR 0 | 89          | 9 | 36 | 1585.07 | 2               | 8  | 12 |
| 10    |             |   | 34 | 1585.06 |                 |    | 2  |
| 20    |             |   | 32 | 1585.04 |                 | 7  | 53 |
| 30    |             |   | 29 | 1585.03 |                 |    | 46 |
| APR 0 | 89          | 9 | 28 | 1585.03 | 2               | 7  | 45 |
| 10    |             |   | 25 | 1585.01 |                 |    | 42 |
| 20    |             |   | 22 | 1585.00 |                 |    | 42 |
| 30    |             |   | 19 | 1584.98 |                 |    | 44 |
| MAY 0 | 89          | 9 | 19 | 1584.98 | 2               | 7  | 44 |
| 10    |             |   | 16 | 1584.97 |                 |    | 49 |
| 20    |             |   | 13 | 1584.96 |                 |    | 56 |
| 30    |             |   | 11 | 1584.94 |                 | 8  | 6  |
| JUN 0 | 89          | 9 | 11 | 1584.94 | 2               | 8  | 7  |
| 10    |             |   | 9  | 1584.93 |                 |    | 18 |
| 20    |             |   | 7  | 1584.93 |                 |    | 31 |
| 30    |             |   | 7  | 1584.92 |                 |    | 46 |
| JUL 0 | 89          | 9 | 7  | 1584.92 | 2               | 8  | 46 |
| 10    |             |   | 6  | 1584.92 |                 | 9  | 1  |
| 20    |             |   | 6  | 1584.92 |                 |    | 16 |
| 30    |             |   | 7  | 1584.92 |                 |    | 31 |
| AUG 0 | 89          | 9 | 7  | 1584.92 | 2               | 9  | 33 |
| 10    |             |   | 8  | 1584.93 |                 |    | 49 |
| 20    |             |   | 10 | 1584.94 |                 | 10 | 3  |
| 30    |             |   | 12 | 1584.95 |                 |    | 16 |
| SEP 0 | 89          | 9 | 12 | 1584.95 | 2               | 10 | 18 |
| 10    |             |   | 15 | 1584.96 |                 |    | 30 |
| 20    |             |   | 18 | 1584.98 |                 |    | 41 |
| 30    |             |   | 21 | 1584.99 |                 |    | 51 |
| OCT 0 | 89          | 9 | 21 | 1584.99 | 2               | 10 | 51 |
| 10    |             |   | 25 | 1585.01 |                 |    | 57 |
| 20    |             |   | 28 | 1585.03 |                 | 11 | 2  |
| 30    |             |   | 32 | 1585.05 |                 |    | 6  |
| NOV 0 | 89          | 9 | 32 | 1585.05 | 2               | 11 | 6  |
| 10    |             |   | 36 | 1585.07 |                 |    | 6  |
| 20    |             |   | 39 | 1585.08 |                 |    | 3  |
| 30    |             |   | 43 | 1585.10 |                 | 10 | 58 |
| DEC 0 | 89          | 9 | 43 | 1585.10 | 2               | 10 | 58 |
| 10    |             |   | 46 | 1585.12 |                 |    | 52 |
| 20    |             |   | 49 | 1585.13 |                 |    | 42 |
| 30    |             |   | 51 | 1585.14 |                 |    | 30 |
| JAN 0 | 89          | 9 | 51 | 1585.14 | 2               | 10 | 29 |

TABLE 12

## TO DETERMINE AZIMUTH FROM POLARIS

**PURPOSE:** The purpose of this table is to provide a fast, simple method of determining 5th order azimuths from observations of Polaris. When the appropriate secant table (following) is used, use of logarithms is unnecessary.

GUIDE FOR USE:

1. Determine Local Siderial Time (L.S.T.) of observation as described in FM 6-2.
2. Enter the table with this L.S.T. and extract the corresponding  $b_0$ ,  $b_1$ , and  $b_2$ .
3. Algebraically add  $b_0$ ,  $b_1$ , and  $b_2$ .
4. Select the appropriate secant table depending whether the results are to be in minutes of arc or mils. It is advisable to "X" out the secant table that will not be used. Using degrees of latitude, extract the corresponding secant and DIFF 1' OF LAT. ( $\times 100000$ ). Round the minutes and seconds of latitude to the nearest whole minute; multiply this by the DIFF 1'; round to the nearest 10; move the decimal 5 places to the left; and add the result to the secant.
5. Multiply the result of 4. above by the sum of  $b_0 + b_1 + b_2$  and round to the nearest 0.1; this, with the sign of  $b_0 + b_1 + b_2$ , is the azimuth angle.
6. Add the azimuth angle algebraically to 6400 mils (or 360 degrees) to get the azimuth to Polaris. Subtract the mean horizontal angle (clockwise, from azimuth mark to Polaris) from the azimuth to Polaris to get the azimuth to the mark. If the azimuth to the mark exceeds 6400, subtract 6400.

EXAMPLE: Required: Astronomic azimuth

Known: L.S.T. of observation = 5 hrs 27 min

Latitude =  $34^{\circ} 37' 45''$ 

Month = May 1976

Mean horizontal angle from mark to Polaris = 1320.5 m

From TABLE 12, 1976:  $b_0 = -38.8$ ,  $b_1 = +.2$ ,  $b_2 = -.3$ 

$$b_0 + b_1 + b_2 = (-38.8) + (+.2) + (-.3) = -38.9$$

Results are needed in mils so the SECANT TABLE, Results in Mils is used.

| DEGREES<br>LATITUDE | SECANT<br>( $\times$ m conv.) | DIFF. 1'<br>OF LAT.<br>( $\times 100000$ ) |
|---------------------|-------------------------------|--------------------------------------------|
| 34                  | 0.3574                        | 7.2                                        |

Minutes and seconds of latitude rounded to nearest whole minute = 38;  $38 \times 7.2 = 273.6$ ; rounding to nearest 10 yields 270; moving the decimal 5 places to the left yields .0027;  $0.3574 + .0027 = 0.3601$

$-38.9 \times 0.3601 = -14.00789$ ; rounded to the nearest 0.1 m this yields AZIMUTH ANGLE = -14.0 m

$$\text{AZIMUTH TO MARK} = -14.0 + 6400 - 1320.5 = \underline{5065.5 \text{ m}}$$

**SECANT TABLE, Results in Mils**

| DEGREES<br>LATITUDE | SECANT<br>(X 10 <sup>5</sup> CONV.) | DIFF. 1'<br>OF LAT.<br>(X 100000) | DEGREES<br>LATITUDE | SECANT<br>(X 10 <sup>5</sup> CONV.) | DIFF. 1'<br>OF LAT.<br>(X 100000) | DEGREES<br>LATITUDE | SECANT<br>(X 10 <sup>5</sup> CONV.) | DIFF. 1'<br>OF LAT.<br>(X 100000) |
|---------------------|-------------------------------------|-----------------------------------|---------------------|-------------------------------------|-----------------------------------|---------------------|-------------------------------------|-----------------------------------|
| 0                   | 0.2963                              | 0.1                               | 23                  | 0.3219                              | 4.1                               | 46                  | 0.4265                              | 13.2                              |
| 1                   | 0.2963                              | 0.2                               | 24                  | 0.3243                              | 4.3                               | 47                  | 0.4345                              | 13.9                              |
| 2                   | 0.2965                              | 0.4                               | 25                  | 0.3269                              | 4.6                               | 48                  | 0.4428                              | 14.7                              |
| 3                   | 0.2967                              | 0.5                               | 26                  | 0.3297                              | 4.8                               | 49                  | 0.4516                              | 15.5                              |
| 4                   | 0.2970                              | 0.7                               | 27                  | 0.3325                              | 5.1                               | 50                  | 0.4610                              | 16.4                              |
| 5                   | 0.2974                              | 0.8                               | 28                  | 0.3356                              | 5.3                               | 51                  | 0.4708                              | 17.4                              |
| 6                   | 0.2979                              | 1.0                               | 29                  | 0.3388                              | 5.6                               | 52                  | 0.4813                              | 18.5                              |
| 7                   | 0.2985                              | 1.1                               | 30                  | 0.3421                              | 5.9                               | 53                  | 0.4923                              | 19.6                              |
| 8                   | 0.2992                              | 1.3                               | 31                  | 0.3457                              | 6.2                               | 54                  | 0.5041                              | 20.8                              |
| 9                   | 0.3000                              | 1.5                               | 32                  | 0.3494                              | 6.5                               | 55                  | 0.5166                              | 22.1                              |
| 10                  | 0.3009                              | 1.6                               | 33                  | 0.3533                              | 6.8                               | 56                  | 0.5299                              | 23.6                              |
| 11                  | 0.3018                              | 1.8                               | 34                  | 0.3574                              | 7.2                               | 57                  | 0.5440                              | 25.2                              |
| 12                  | 0.3029                              | 2.0                               | 35                  | 0.3617                              | 7.6                               | 58                  | 0.5591                              | 26.9                              |
| 13                  | 0.3041                              | 2.1                               | 36                  | 0.3662                              | 7.9                               | 59                  | 0.5753                              | 28.8                              |
| 14                  | 0.3054                              | 2.3                               | 37                  | 0.3710                              | 8.3                               | 60                  | 0.5926                              | 30.9                              |
| 15                  | 0.3067                              | 2.5                               | 38                  | 0.3760                              | 8.8                               | 61                  | 0.6112                              | 33.3                              |
| 16                  | 0.3082                              | 2.7                               | 39                  | 0.3813                              | 9.2                               | 62                  | 0.6311                              | 35.9                              |
| 17                  | 0.3098                              | 2.8                               | 40                  | 0.3868                              | 9.7                               | 63                  | 0.6526                              | 38.8                              |
| 18                  | 0.3115                              | 3.0                               | 41                  | 0.3926                              | 10.2                              | 64                  | 0.6759                              | 42.0                              |
| 19                  | 0.3134                              | 3.2                               | 42                  | 0.3987                              | 10.7                              | 65                  | 0.7011                              | 45.6                              |
| 20                  | 0.3153                              | 3.4                               | 43                  | 0.4051                              | 11.3                              | 66                  | 0.7285                              | 49.7                              |
| 21                  | 0.3174                              | 3.6                               | 44                  | 0.4119                              | 11.9                              | 67                  | 0.7583                              |                                   |
| 22                  | 0.3196                              | 3.9                               | 45                  | 0.4190                              | 12.5                              |                     |                                     |                                   |

**SECANT TABLE, Results in Minutes of Arc**

| DEGREES<br>LATITUDE | NATURAL<br>SECANT | DIFF. 1'<br>OF LAT.<br>(X 100000) | DEGREES<br>LATITUDE | NATURAL<br>SECANT | DIFF. 1'<br>OF LAT.<br>(X 100000) | DEGREES<br>LATITUDE | NATURAL<br>SECANT | DIFF. 1'<br>OF LAT.<br>(X 100000) |
|---------------------|-------------------|-----------------------------------|---------------------|-------------------|-----------------------------------|---------------------|-------------------|-----------------------------------|
| 0                   | 1.000             | 0.                                | 23                  | 1.086             | 14.                               | 46                  | 1.440             | 45.                               |
| 1                   | 1.000             | 1.                                | 24                  | 1.095             | 15.                               | 47                  | 1.466             | 47.                               |
| 2                   | 1.001             | 1.                                | 25                  | 1.103             | 15.                               | 48                  | 1.494             | 50.                               |
| 3                   | 1.001             | 2.                                | 26                  | 1.113             | 16.                               | 49                  | 1.524             | 52.                               |
| 4                   | 1.002             | 2.                                | 27                  | 1.122             | 17.                               | 50                  | 1.556             | 55.                               |
| 5                   | 1.004             | 3.                                | 28                  | 1.133             | 18.                               | 51                  | 1.589             | 59.                               |
| 6                   | 1.006             | 3.                                | 29                  | 1.143             | 19.                               | 52                  | 1.624             | 62.                               |
| 7                   | 1.008             | 4.                                | 30                  | 1.155             | 20.                               | 53                  | 1.662             | 66.                               |
| 8                   | 1.010             | 4.                                | 31                  | 1.167             | 21.                               | 54                  | 1.701             | 70.                               |
| 9                   | 1.012             | 5.                                | 32                  | 1.179             | 22.                               | 55                  | 1.743             | 75.                               |
| 10                  | 1.015             | 5.                                | 33                  | 1.192             | 23.                               | 56                  | 1.788             | 80.                               |
| 11                  | 1.019             | 6.                                | 34                  | 1.206             | 24.                               | 57                  | 1.836             | 85.                               |
| 12                  | 1.022             | 7.                                | 35                  | 1.221             | 25.                               | 58                  | 1.887             | 91.                               |
| 13                  | 1.026             | 7.                                | 36                  | 1.236             | 27.                               | 59                  | 1.942             | 97.                               |
| 14                  | 1.031             | 8.                                | 37                  | 1.252             | 28.                               | 60                  | 2.000             | 104.                              |
| 15                  | 1.035             | 8.                                | 38                  | 1.269             | 30.                               | 61                  | 2.063             | 112.                              |
| 16                  | 1.040             | 9.                                | 39                  | 1.287             | 31.                               | 62                  | 2.130             | 121.                              |
| 17                  | 1.046             | 10.                               | 40                  | 1.305             | 33.                               | 63                  | 2.203             | 131.                              |
| 18                  | 1.051             | 10.                               | 41                  | 1.325             | 34.                               | 64                  | 2.281             | 142.                              |
| 19                  | 1.058             | 11.                               | 42                  | 1.346             | 36.                               | 65                  | 2.366             | 154.                              |
| 20                  | 1.064             | 12.                               | 43                  | 1.367             | 38.                               | 66                  | 2.459             | 168.                              |
| 21                  | 1.071             | 12.                               | 44                  | 1.390             | 40.                               | 67                  | 2.559             |                                   |
| 22                  | 1.079             | 13.                               | 45                  | 1.414             | 42.                               |                     |                   |                                   |

**TABLE 12. TO DETERMINE AZIMUTH FROM POLARIS, 1976**

| L.S.T. | 0 <sup>h</sup>        | 1 <sup>h</sup>        | 2 <sup>h</sup>        | 3 <sup>h</sup>        | 4 <sup>h</sup>        | 5 <sup>h</sup>        | 6 <sup>h</sup>        | 7 <sup>h</sup>        | 8 <sup>h</sup>        | 9 <sup>h</sup>        | 10 <sup>h</sup>       | 11 <sup>h</sup>       |
|--------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|        | <i>b</i> <sub>0</sub> | <i>b</i> <sub>0</sub> | <i>b</i> <sub>0</sub> | <i>b</i> <sub>0</sub> | <i>b</i> <sub>0</sub> | <i>b</i> <sub>0</sub> | <i>b</i> <sub>0</sub> | <i>b</i> <sub>0</sub> | <i>b</i> <sub>0</sub> | <i>b</i> <sub>0</sub> | <i>b</i> <sub>0</sub> | <i>b</i> <sub>0</sub> |
| m      |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |                       |
| 0      | +27.3                 | +15.2                 | + 2.0                 | -11.3                 | -23.9                 | -34.7                 | -43.1                 | -48.5                 | -50.5                 | -49.1                 | -44.3                 | -36.6                 |
| 3      | 26.8                  | 14.6                  | 1.3                   | 12.0                  | 24.5                  | 35.2                  | 43.5                  | 48.7                  | 50.5                  | 48.9                  | 44.0                  | 36.2                  |
| 6      | 26.2                  | 13.9                  | + 0.7                 | 12.6                  | 25.1                  | 35.7                  | 43.8                  | 48.8                  | 50.5                  | 48.7                  | 43.7                  | 35.7                  |
| 9      | 25.6                  | 13.3                  | 0.0                   | 13.3                  | 25.6                  | 36.2                  | 44.1                  | 49.0                  | 50.5                  | 48.6                  | 43.4                  | 35.3                  |
| 12     | 25.1                  | 12.6                  | - 0.7                 | 13.9                  | 26.2                  | 36.6                  | 44.4                  | 49.2                  | 50.5                  | 48.4                  | 43.0                  | 34.8                  |
| 15     | +24.5                 | +12.0                 | - 1.3                 | -14.6                 | -26.8                 | -37.1                 | -44.8                 | -49.3                 | -50.5                 | -48.2                 | -42.7                 | -34.3                 |
| 18     | 23.9                  | 11.3                  | 2.0                   | 15.2                  | 27.3                  | 37.5                  | 45.1                  | 49.4                  | 50.4                  | 48.0                  | 42.3                  | 33.8                  |
| 21     | 23.3                  | 10.7                  | 2.7                   | 15.9                  | 27.9                  | 38.0                  | 45.4                  | 49.6                  | 50.4                  | 47.8                  | 41.9                  | 33.4                  |
| 24     | 22.7                  | 10.0                  | 3.4                   | 16.5                  | 28.5                  | 38.4                  | 45.6                  | 49.7                  | 50.3                  | 47.6                  | 41.6                  | 32.9                  |
| 27     | 22.1                  | 9.4                   | 4.0                   | 17.1                  | 29.0                  | 38.8                  | 45.9                  | 49.8                  | 50.3                  | 47.3                  | 41.2                  | 32.4                  |
| 30     | +21.5                 | + 8.7                 | - 4.7                 | -17.8                 | -29.6                 | -39.3                 | -46.2                 | -49.9                 | -50.2                 | -47.1                 | -40.8                 | -31.9                 |
| 33     | 20.9                  | 8.0                   | 5.4                   | 18.4                  | 30.1                  | 39.7                  | 46.5                  | 50.0                  | 50.1                  | 46.9                  | 40.4                  | 31.3                  |
| 36     | 20.3                  | 7.4                   | 6.0                   | 19.0                  | 30.6                  | 40.1                  | 46.7                  | 50.1                  | 50.0                  | 46.6                  | 40.0                  | 30.8                  |
| 39     | 19.6                  | 6.7                   | 6.7                   | 19.6                  | 31.2                  | 40.5                  | 47.0                  | 50.2                  | 50.0                  | 46.3                  | 39.6                  | 30.3                  |
| 42     | 19.0                  | 6.0                   | 7.4                   | 20.3                  | 31.7                  | 40.9                  | 47.2                  | 50.3                  | 49.9                  | 46.1                  | 39.2                  | 29.8                  |
| 45     | +18.4                 | + 5.4                 | - 8.0                 | -20.9                 | -32.2                 | -41.3                 | -47.4                 | -50.3                 | -49.7                 | -45.8                 | -38.8                 | -29.3                 |
| 48     | 17.8                  | 4.7                   | 8.7                   | 21.5                  | 32.7                  | 41.7                  | 47.7                  | 50.4                  | 49.6                  | 45.5                  | 38.4                  | 28.7                  |
| 51     | 17.1                  | 4.0                   | 9.4                   | 22.1                  | 33.2                  | 42.0                  | 47.9                  | 50.4                  | 49.5                  | 45.2                  | 38.0                  | 28.2                  |
| 54     | 16.5                  | 3.4                   | 10.0                  | 22.7                  | 33.7                  | 42.4                  | 48.1                  | 50.4                  | 49.4                  | 44.9                  | 37.5                  | 27.6                  |
| 57     | 15.9                  | 2.7                   | 10.7                  | 23.3                  | 34.2                  | 42.8                  | 48.3                  | 50.5                  | 49.2                  | 44.6                  | 37.1                  | 27.1                  |
| 60     | +15.2                 | + 2.0                 | -11.3                 | -23.9                 | -34.7                 | -43.1                 | -48.5                 | -50.5                 | -49.1                 | -44.3                 | -36.6                 | -26.5                 |
| Lat.   | <i>b</i> <sub>1</sub> | <i>b</i> <sub>1</sub> | <i>b</i> <sub>1</sub> | <i>b</i> <sub>1</sub> | <i>b</i> <sub>1</sub> | <i>b</i> <sub>1</sub> | <i>b</i> <sub>1</sub> | <i>b</i> <sub>1</sub> | <i>b</i> <sub>1</sub> | <i>b</i> <sub>1</sub> | <i>b</i> <sub>1</sub> | <i>b</i> <sub>1</sub> |
| 0      | -.3                   | -.1                   | +.1                   | +.3                   | +.4                   | +.4                   | +.3                   | +.1                   | -.1                   | -.3                   | -.4                   | -.4                   |
| 10     | -.3                   | -.1                   | +.1                   | +.2                   | +.4                   | +.4                   | +.3                   | +.1                   | -.1                   | -.2                   | -.4                   | -.4                   |
| 20     | -.2                   | -.1                   | +.1                   | +.2                   | +.3                   | +.3                   | +.2                   | +.1                   | -.1                   | -.2                   | -.3                   | -.3                   |
| 30     | -.2                   | -.1                   | .0                    | +.1                   | +.2                   | +.2                   | +.2                   | +.1                   | .0                    | -.1                   | -.2                   | -.2                   |
| 40     | -.1                   | .0                    | .0                    | +.1                   | +.1                   | +.1                   | +.1                   | .0                    | .0                    | -.1                   | -.1                   | -.1                   |
| 45     | -.1                   | .0                    | .0                    | .0                    | +.1                   | +.1                   | +.1                   | .0                    | .0                    | .0                    | -.1                   | -.1                   |
| 50     | .0                    | .0                    | .0                    | .0                    | .0                    | .0                    | .0                    | .0                    | .0                    | .0                    | .0                    | .0                    |
| 55     | +.1                   | .0                    | .0                    | -.1                   | -.1                   | -.1                   | -.1                   | .0                    | .0                    | +.1                   | +.1                   | +.1                   |
| 60     | +.2                   | +.1                   | .0                    | -.1                   | -.2                   | -.2                   | -.2                   | -.1                   | .0                    | +.1                   | +.2                   | +.2                   |
| 62     | +.2                   | +.1                   | .0                    | -.2                   | -.2                   | -.3                   | -.2                   | -.1                   | .0                    | +.2                   | +.2                   | +.3                   |
| 64     | +.2                   | +.1                   | -.1                   | -.2                   | -.3                   | -.3                   | -.2                   | -.1                   | +.1                   | +.2                   | +.3                   | +.3                   |
| 66     | +.3                   | +.1                   | -.1                   | -.3                   | -.4                   | -.4                   | -.3                   | -.1                   | +.1                   | +.3                   | +.4                   | +.4                   |
| Month  | <i>b</i> <sub>2</sub> | <i>b</i> <sub>2</sub> | <i>b</i> <sub>2</sub> | <i>b</i> <sub>2</sub> | <i>b</i> <sub>2</sub> | <i>b</i> <sub>2</sub> | <i>b</i> <sub>2</sub> | <i>b</i> <sub>2</sub> | <i>b</i> <sub>2</sub> | <i>b</i> <sub>2</sub> | <i>b</i> <sub>2</sub> | <i>b</i> <sub>2</sub> |
| Jan.   | .0                    | .0                    | +.1                   | +.1                   | +.1                   | +.1                   | +.1                   | +.1                   | +.1                   | +.1                   | +.1                   | +.1                   |
| Feb.   | -.2                   | -.1                   | -.1                   | -.1                   | .0                    | .0                    | +.1                   | +.1                   | +.1                   | +.2                   | +.2                   | +.2                   |
| Mar.   | -.2                   | -.2                   | -.2                   | -.2                   | -.2                   | -.1                   | -.1                   | .0                    | +.1                   | +.1                   | +.2                   | +.2                   |
| Apr.   | -.2                   | -.3                   | -.3                   | -.3                   | -.3                   | -.3                   | -.2                   | -.2                   | -.1                   | .0                    | +.1                   | +.1                   |
| May    | -.1                   | -.2                   | -.3                   | -.3                   | -.3                   | -.3                   | -.3                   | -.3                   | -.2                   | -.2                   | -.1                   | .0                    |
| June   | .0                    | -.1                   | -.2                   | -.2                   | -.3                   | -.3                   | -.4                   | -.4                   | -.3                   | -.3                   | -.2                   | -.1                   |
| July   | +.2                   | +.1                   | .0                    | -.1                   | -.2                   | -.3                   | -.3                   | -.4                   | -.4                   | -.4                   | -.3                   | -.3                   |
| Aug.   | +.3                   | +.3                   | +.2                   | +.1                   | .0                    | -.1                   | -.2                   | -.3                   | -.4                   | -.4                   | -.4                   | -.4                   |
| Sept.  | +.4                   | +.4                   | +.3                   | +.3                   | +.2                   | +.1                   | .0                    | -.2                   | -.2                   | -.3                   | -.4                   | -.4                   |
| Oct.   | +.4                   | +.4                   | +.4                   | +.4                   | +.3                   | +.2                   | +.1                   | .0                    | -.1                   | -.2                   | -.3                   | -.4                   |
| Nov.   | +.3                   | +.4                   | +.5                   | +.5                   | +.4                   | +.4                   | +.3                   | +.2                   | +.1                   | .0                    | -.1                   | -.3                   |
| Dec.   | +.2                   | +.3                   | +.4                   | +.5                   | +.5                   | +.5                   | +.4                   | +.3                   | +.2                   | +.1                   | .0                    | -.1                   |

Azimuth of Polaris is product of (*b*<sub>0</sub>+*b*<sub>1</sub>+*b*<sub>2</sub>) by secant of latitude.

TABLE 12. TO DETERMINE AZIMUTH FROM POLARIS, 1976 - CONTINUED

| L.S.T. | 12 <sup>h</sup> | 13 <sup>h</sup> | 14 <sup>h</sup> | 15 <sup>h</sup> | 16 <sup>h</sup> | 17 <sup>h</sup> | 18 <sup>h</sup> | 19 <sup>h</sup> | 20 <sup>h</sup> | 21 <sup>h</sup> | 22 <sup>h</sup> | 23 <sup>h</sup> |
|--------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|        | $b_0$           | $b_0$           | $b_0$           | $b_0$           | $b_0$           | $b_0$           | $b_0$           | $b_0$           | $b_0$           | $b_0$           | $b_0$           | $b_0$           |
| m      |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| 0      | -26.5           | -14.7           | - 1.9           | +11.0           | +23.1           | +33.8           | +42.3           | +48.0           | +50.4           | +49.4           | +45.1           | +37.5           |
| 3      | 26.0            | 14.1            | 1.3             | 11.6            | 23.7            | 34.3            | 42.7            | 48.2            | 50.5            | 49.3            | 44.8            | 37.1            |
| 6      | 25.4            | 13.5            | - 0.6           | 12.2            | 24.3            | 34.8            | 43.0            | 48.4            | 50.5            | 49.2            | 44.4            | 36.6            |
| 9      | 24.9            | 12.8            | 0.0             | 12.8            | 24.9            | 35.3            | 43.4            | 48.6            | 50.5            | 49.0            | 44.1            | 36.2            |
| 12     | 24.3            | 12.2            | + 0.6           | 13.5            | 25.4            | 35.7            | 43.7            | 48.7            | 50.5            | 48.8            | 43.8            | 35.7            |
| 15     | -23.7           | -11.6           | + 1.3           | +14.1           | +26.0           | +36.2           | +44.0           | +48.9           | +50.5           | +48.7           | +43.5           | +35.2           |
| 18     | 23.1            | 11.0            | 1.9             | 14.7            | 26.5            | 36.6            | 44.3            | 49.1            | 50.5            | 48.5            | 43.1            | 34.7            |
| 21     | 22.6            | 10.3            | 2.6             | 15.3            | 27.1            | 37.1            | 44.6            | 49.2            | 50.5            | 48.3            | 42.8            | 34.2            |
| 24     | 22.0            | 9.7             | 3.2             | 16.0            | 27.6            | 37.5            | 44.9            | 49.4            | 50.4            | 48.1            | 42.4            | 33.7            |
| 27     | 21.4            | 9.0             | 3.9             | 16.6            | 28.2            | 38.0            | 45.2            | 49.5            | 50.4            | 47.9            | 42.0            | 33.2            |
| 30     | -20.8           | - 8.4           | + 4.5           | +17.2           | +28.7           | +38.4           | +45.5           | +49.6           | +50.1           | +47.7           | +41.7           | +32.7           |
| 33     | 20.2            | 7.8             | 5.2             | 17.8            | 29.3            | 38.8            | 45.8            | 49.7            | 50.3            | 47.4            | 41.3            | 32.2            |
| 36     | 19.6            | 7.1             | 5.8             | 18.4            | 29.8            | 39.2            | 46.1            | 49.9            | 50.3            | 47.2            | 40.9            | 31.7            |
| 39     | 19.0            | 6.5             | 6.5             | 19.0            | 30.3            | 39.6            | 46.3            | 50.0            | 50.2            | 47.0            | 40.5            | 31.2            |
| 42     | 18.4            | 5.8             | 7.1             | 19.6            | 30.8            | 40.0            | 46.6            | 50.0            | 50.1            | 46.7            | 40.1            | 30.6            |
| 45     | -17.8           | - 5.2           | + 7.8           | +20.2           | +31.3           | +40.4           | +46.9           | +50.1           | +50.0           | +46.5           | +39.7           | +30.1           |
| 48     | 17.2            | -4.5            | 8.4             | 20.8            | 31.9            | 40.8            | 47.1            | 50.2            | 49.9            | 46.2            | 39.3            | 29.6            |
| 51     | 16.6            | 3.9             | 9.0             | 21.4            | 32.4            | 41.2            | 47.3            | 50.3            | 49.8            | 45.9            | 38.8            | 29.0            |
| 54     | 16.0            | 3.2             | 9.7             | 22.0            | 32.9            | 41.6            | 47.6            | 50.3            | 49.7            | 45.6            | 38.4            | 28.5            |
| 57     | 15.3            | 2.6             | 10.3            | 22.6            | 33.4            | 41.9            | 47.8            | 50.4            | 49.6            | 45.4            | 38.0            | 27.9            |
| 60     | -14.7           | - 1.9           | +11.0           | +23.1           | +33.8           | +42.3           | +48.0           | +50.4           | +49.4           | +45.1           | +37.5           | +27.3           |
| Lat.   | $b_1$           | $b_1$           | $b_1$           | $b_1$           | $b_1$           | $b_1$           | $b_1$           | $b_1$           | $b_1$           | $b_1$           | $b_1$           | $b_1$           |
| °      |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |                 |
| 0      | - .3            | - .1            | + .1            | + .3            | + .4            | + .4            | + .3            | + .1            | - .1            | - .3            | - .4            | - .4            |
| 10     | - .3            | - .1            | + .1            | + .2            | + .4            | + .4            | + .3            | + .1            | - .1            | - .2            | - .4            | - .4            |
| 20     | - .2            | - .1            | + .1            | + .2            | + .3            | + .3            | + .2            | + .1            | - .1            | - .2            | - .3            | - .3            |
| 30     | - .2            | - .1            | .0              | + .1            | + .2            | + .2            | + .2            | + .1            | .0              | - .1            | - .2            | - .2            |
| 40     | - .1            | .0              | .0              | + .1            | + .1            | + .1            | + .1            | .0              | .0              | - .1            | - .1            | - .1            |
| 45     | - .1            | .0              | .0              | .0              | + .1            | + .1            | + .1            | .0              | .0              | .0              | - .1            | - .1            |
| 50     | .0              | .0              | .0              | .0              | .0              | .0              | .0              | .0              | .0              | .0              | .0              | .0              |
| 55     | + .1            | .0              | .0              | - .1            | - .1            | - .1            | - .1            | .0              | .0              | + .1            | + .1            | + .1            |
| 60     | + .2            | + .1            | .0              | - .1            | - .2            | - .2            | - .2            | - .1            | .0              | + .1            | + .2            | + .2            |
| 62     | + .2            | + .1            | .0              | - .2            | - .2            | - .3            | - .2            | - .1            | .0              | + .2            | + .2            | + .3            |
| 64     | + .2            | + .1            | - .1            | - .2            | - .3            | - .3            | - .2            | - .1            | + .1            | + .2            | + .3            | + .3            |
| 66     | + .3            | + .1            | - .1            | - .3            | - .4            | - .4            | - .3            | - .1            | + .1            | + .3            | + .4            | + .4            |
| Month  | $b_2$           | $b_2$           | $b_2$           | $b_2$           | $b_2$           | $b_2$           | $b_2$           | $b_2$           | $b_2$           | $b_2$           | $b_2$           | $b_2$           |
| Jan    | .0              | .0              | - .1            | - .1            | - .1            | - .1            | - .1            | - .1            | - .1            | - .1            | - .1            | - .1            |
| Feb.   | + .2            | + .1            | + .1            | + .1            | .0              | .0              | - .1            | - .1            | - .1            | - .2            | - .2            | - .2            |
| Mar.   | + .2            | + .2            | + .2            | + .2            | + .2            | + .1            | + .1            | .0              | - .1            | - .1            | - .2            | - .2            |
| Apr.   | + .2            | + .3            | + .3            | + .3            | + .3            | + .3            | + .2            | + .2            | + .1            | .0              | - .1            | - .1            |
| May    | + .1            | + .2            | + .3            | + .3            | + .3            | + .3            | + .3            | + .3            | + .2            | + .2            | + .1            | .0              |
| June   | .0              | + .1            | + .2            | + .2            | + .3            | + .3            | + .4            | + .4            | + .3            | + .3            | + .2            | + .1            |
| July   | - .2            | - .1            | .0              | + .1            | + .2            | + .3            | + .3            | + .4            | + .4            | + .4            | + .3            | + .3            |
| Aug.   | - .3            | - .3            | - .2            | - .1            | .0              | + .1            | + .2            | + .3            | + .4            | + .4            | + .4            | + .4            |
| Sept.  | - .4            | - .4            | - .3            | - .3            | - .2            | - .1            | .0              | + .2            | + .2            | + .3            | + .4            | + .4            |
| Oct.   | - .4            | - .4            | - .4            | - .4            | - .3            | - .2            | - .1            | .0              | + .1            | + .2            | + .3            | + .4            |
| Nov.   | - .3            | - .4            | - .5            | - .5            | - .4            | - .4            | - .3            | - .2            | - .1            | .0              | + .1            | + .3            |
| Dec.   | - .2            | - .3            | - .4            | - .5            | - .5            | - .5            | - .4            | - .3            | - .2            | - .1            | .0              | + .1            |

Azimuth of Polaris is product of  $(b_0+b_1+b_2)$  by secant of latitude.

TABLE 13. Grid Azimuth Correction, Simultaneous Observation

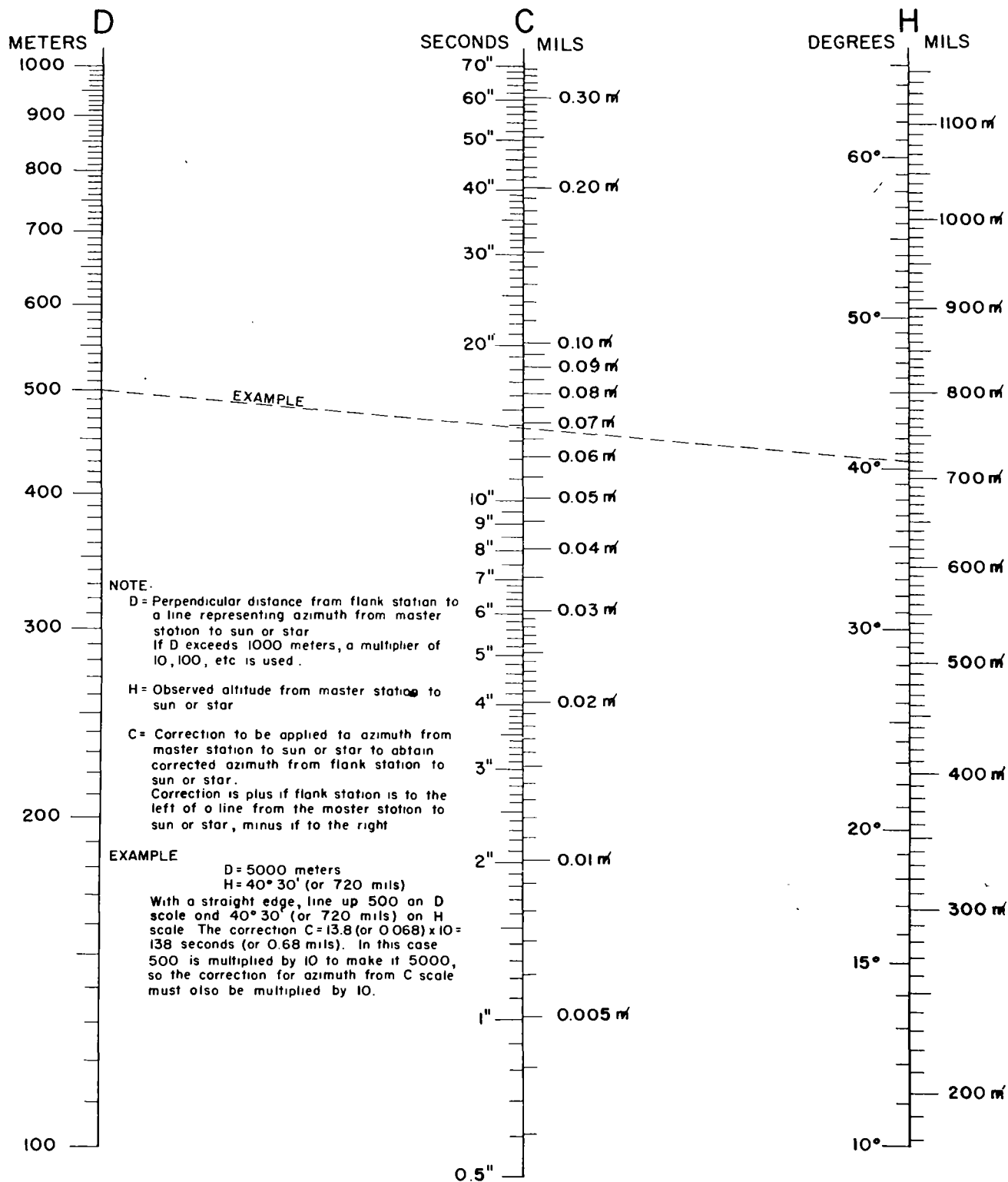




TABLE 14  
ZONE TO ZONE AZIMUTH TRANSFORMATION TABLE

PURPOSE: The purpose of this table is to provide a method for the conversion of UTM grid azimuths in one zone into the corresponding azimuths at an adjacent zone. The table is designed for use in the area between the respective central meridians of the adjacent zones; however, it will yield accurate results a moderate distance outside this area. Results are in mils.

GUIDE FOR USE:

1. Coordinates must be transformed to the adjacent zone by use of TM 5-241-2 or other means.
2. The northing coordinates in each zone are added together. This "total northing" (N) is rounded to the nearest 100 (4th order) or 1000 (5th order). In the Southern Hemisphere the total N must be subtracted from 20,000,000 before entering the table.
3. Find the tabulated N's between which the total N lies, subtract the lower tabulated N from the total N and move the decimal 5 places to the left.
4. Multiply this by the "DIFF IN C" located opposite the lower tabulated N.
5. Add this product to the "C" opposite the lower tabulated value. In 5th order computations this is the change in azimuth; 4th order accuracy requires the following steps.
6. Subtract the smaller of the 2 N's of the point from the larger, round to the nearest 100, and move the decimal 3 places to the left. If the resulting number is smaller than the "ALLOWABLE DIFF IN N" opposite the lower tabulated N no further computations are required and the result from 5 above is the correct change in azimuth. If it is larger, complete the following steps.
7. Square the computed number.
8. Extract from the table the F closest the total N, multiply it by the squared number, round to nearest whole number and move the decimal 3 places to the left.
9. Add the resulting number to the result of 5 above. The sum is the change in azimuth.
10. The sign of the change in azimuth is determined by use of the following chart:

When the point is transformed from:

(Northern Hemisphere)

East to West, sign is -  
West to East, sign is +

(Southern Hemisphere)

East to West, sign is +  
West to East, sign is -

## EXAMPLE: (5th ORDER ACCURACY)

Required: Change in azimuth (C) to nearest 0.1  $\mu$ .

Known: N (Zone 15) = 3833384

N (Zone 14) = 3830861

$3833384 + 3830861 = 7664245$ ; round to 7664000 which lies between 7600000 and 7700000 in the table.

$7664000 - 7600000 = 64000$ ; moving the decimal 5 places to the left yields 0.64

| N         | C      | DIFF IN C |
|-----------|--------|-----------|
| 7 600 000 | 60.157 | .691      |

$C = 60.157 + (0.64 \times .691) = 60.157 + .442 = 60.599$

Rounded to the nearest 0.1  $\mu$ ,  $C = 60.6 \mu$

## EXAMPLE: (4th ORDER ACCURACY)

Required: Change in azimuth (C) to nearest 0.001  $\mu$ .

Known: N (Zone 15) = 3834767

N (Zone 14) = 3830679

$3834767 + 3830679 = 7665446$ ; round to 7665400 which lies between 7600000 and 7700000 in the table.

$7665400 - 7600000 = 65400$ ; moving the decimal 5 places to the left yields 0.654

| N         | C      | DIFF IN C | ALLOWABLE<br>DIFF IN N | F    |
|-----------|--------|-----------|------------------------|------|
| 7 600 000 | 60.157 | .691      | 1.53                   | 0.21 |
| 7 700 000 |        |           | 1.54                   | 0.21 |

$C = 60.157 + (0.654 \times .691) = 60.157 + .452 = 60.609 \mu$

$3834767 - 3830679 = 4088$ ; rounding to the nearest 100 and moving the decimal 3 places to the left yields 4.1 which is larger than the closest ALLOWABLE DIFF IN N (1.54). Therefore, further computations are required.

$4.1 \text{ squared} = 4.1 \times 4.1 = 16.8$ ;  $16.8 \times F = 16.8 \times 0.21 = 3.53$ ; rounding to the nearest whole number and moving the decimal 3 places to the left yields .004

$C = 60.609 + .004 = \underline{60.613 \mu}$

| N   |         | C      | DIFF IN C | ALLOWABLE<br>DIFF IN N | F     |
|-----|---------|--------|-----------|------------------------|-------|
|     | 0       | 0.0    | .842      | ★                      | ★     |
| 100 | 000     | 0.842  | .842      | 0.18                   | 15.24 |
| 200 | 000     | 1.684  | .841      | 0.26                   | 7.62  |
| 300 | 000     | 2.525  | .842      | 0.31                   | 5.08  |
| 400 | 000     | 3.367  | .841      | 0.36                   | 3.81  |
| 500 | 000     | 4.208  | .841      | 0.40                   | 3.05  |
| 600 | 000     | 5.049  | .841      | 0.44                   | 2.54  |
| 700 | 000     | 5.890  | .840      | 0.48                   | 2.18  |
| 800 | 000     | 6.730  | .840      | 0.51                   | 1.91  |
| 900 | 000     | 7.570  | .840      | 0.54                   | 1.70  |
| 1   | 000 000 | 8.410  | .838      | 0.57                   | 1.53  |
| 1   | 100 000 | 9.248  | .839      | 0.60                   | 1.39  |
| 1   | 200 000 | 10.087 | .837      | 0.63                   | 1.27  |
| 1   | 300 000 | 10.924 | .837      | 0.65                   | 1.18  |
| 1   | 400 000 | 11.761 | .837      | 0.68                   | 1.09  |
| 1   | 500 000 | 12.598 | .835      | 0.70                   | 1.02  |
| 1   | 600 000 | 13.433 | .835      | 0.72                   | 0.96  |
| 1   | 700 000 | 14.268 | .833      | 0.75                   | 0.90  |
| 1   | 800 000 | 15.101 | .833      | 0.77                   | 0.85  |
| 1   | 900 000 | 15.934 | .832      | 0.79                   | 0.81  |
| 2   | 000 000 | 16.766 | .830      | 0.81                   | 0.77  |
| 2   | 100 000 | 17.596 | .830      | 0.83                   | 0.73  |
| 2   | 200 000 | 18.426 | .828      | 0.85                   | 0.70  |
| 2   | 300 000 | 19.254 | .827      | 0.87                   | 0.67  |
| 2   | 400 000 | 20.081 | .826      | 0.88                   | 0.64  |
| 2   | 500 000 | 20.907 | .825      | 0.90                   | 0.61  |
| 2   | 600 000 | 21.732 | .823      | 0.92                   | 0.59  |
| 2   | 700 000 | 22.555 | .822      | 0.94                   | 0.57  |
| 2   | 800 000 | 23.377 | .820      | 0.95                   | 0.55  |
| 2   | 900 000 | 24.197 | .819      | 0.97                   | 0.53  |
| 3   | 000 000 | 25.016 | .817      | 0.99                   | 0.51  |
| 3   | 100 000 | 25.833 | .815      | 1.00                   | 0.50  |
| 3   | 200 000 | 26.648 | .814      | 1.02                   | 0.48  |
| 3   | 300 000 | 27.462 | .812      | 1.03                   | 0.47  |
| 3   | 400 000 | 28.274 | .810      | 1.05                   | 0.45  |
| 3   | 500 000 | 29.084 | .809      | 1.06                   | 0.44  |
| 3   | 600 000 | 29.893 | .806      | 1.08                   | 0.43  |
| 3   | 700 000 | 30.699 | .805      | 1.09                   | 0.42  |
| 3   | 800 000 | 31.504 | .803      | 1.11                   | 0.41  |
| 3   | 900 000 | 32.307 | .800      | 1.12                   | 0.40  |
| 4   | 000 000 | 33.107 | .799      | 1.14                   | 0.39  |
| 4   | 100 000 | 33.906 | .796      | 1.15                   | 0.38  |
| 4   | 200 000 | 34.702 | .794      | 1.16                   | 0.37  |
| 4   | 300 000 | 35.496 | .792      | 1.18                   | 0.36  |
| 4   | 400 000 | 36.288 | .790      | 1.19                   | 0.35  |
| 4   | 500 000 | 37.078 | .787      | 1.20                   | 0.35  |
| 4   | 600 000 | 37.865 | .785      | 1.22                   | 0.34  |
| 4   | 700 000 | 38.650 | .782      | 1.23                   | 0.33  |
| 4   | 800 000 | 39.432 | .780      | 1.24                   | 0.33  |
| 4   | 900 000 | 40.212 | .778      | 1.25                   | 0.32  |
| 5   | 000 000 | 40.990 | .774      | 1.26                   | 0.31  |
| 5   | 100 000 | 41.764 | .773      | 1.28                   | 0.31  |
| 5   | 200 000 | 42.537 | .769      | 1.29                   | 0.30  |
| 5   | 300 000 | 43.306 | .767      | 1.30                   | 0.30  |
| 5   | 400 000 | 44.073 | .764      | 1.31                   | 0.29  |
| 5   | 500 000 | 44.837 | .761      | 1.32                   | 0.29  |
| 5   | 600 000 | 45.598 | .758      | 1.33                   | 0.28  |
| 5   | 700 000 | 46.356 | .756      | 1.35                   | 0.28  |
| 5   | 800 000 | 47.112 | .752      | 1.36                   | 0.27  |
| 5   | 900 000 | 47.864 | .750      | 1.37                   | 0.27  |

★ F CORRECTION NOT REQUIRED

|            |        | ALLOWABLE |           |      |
|------------|--------|-----------|-----------|------|
| N          | C      | DIFF IN C | DIFF IN N | F    |
| 6 000 000  | 48.614 | .746      | 1.38      | 0.26 |
| 6 100 000  | 49.360 | .743      | 1.39      | 0.26 |
| 6 200 000  | 50.103 | .740      | 1.40      | 0.26 |
| 6 300 000  | 50.843 | .737      | 1.41      | 0.25 |
| 6 400 000  | 51.580 | .734      | 1.42      | 0.25 |
| 6 500 000  | 52.314 | .730      | 1.43      | 0.25 |
| 6 600 000  | 53.044 | .727      | 1.44      | 0.24 |
| 6 700 000  | 53.771 | .724      | 1.45      | 0.24 |
| 6 800 000  | 54.495 | .720      | 1.46      | 0.24 |
| 6 900 000  | 55.215 | .717      | 1.47      | 0.23 |
| 7 000 000  | 55.932 | .713      | 1.48      | 0.23 |
| 7 100 000  | 56.645 | .710      | 1.49      | 0.23 |
| 7 200 000  | 57.355 | .706      | 1.50      | 0.22 |
| 7 300 000  | 58.061 | .702      | 1.51      | 0.22 |
| 7 400 000  | 58.763 | .699      | 1.52      | 0.22 |
| 7 500 000  | 59.462 | .695      | 1.52      | 0.22 |
| 7 600 000  | 60.157 | .691      | 1.53      | 0.21 |
| 7 700 000  | 60.848 | .688      | 1.54      | 0.21 |
| 7 800 000  | 61.536 | .683      | 1.55      | 0.21 |
| 7 900 000  | 62.219 | .680      | 1.56      | 0.21 |
| 8 000 000  | 62.899 | .675      | 1.57      | 0.20 |
| 8 100 000  | 63.574 | .672      | 1.58      | 0.20 |
| 8 200 000  | 64.246 | .668      | 1.59      | 0.20 |
| 8 300 000  | 64.914 | .664      | 1.59      | 0.20 |
| 8 400 000  | 65.578 | .659      | 1.60      | 0.20 |
| 8 500 000  | 66.237 | .656      | 1.61      | 0.19 |
| 8 600 000  | 66.893 | .651      | 1.62      | 0.19 |
| 8 700 000  | 67.544 | .647      | 1.63      | 0.19 |
| 8 800 000  | 68.191 | .643      | 1.63      | 0.19 |
| 8 900 000  | 68.834 | .638      | 1.64      | 0.19 |
| 9 000 000  | 69.472 | .634      | 1.65      | 0.18 |
| 9 100 000  | 70.106 | .630      | 1.66      | 0.18 |
| 9 200 000  | 70.736 | .625      | 1.66      | 0.18 |
| 9 300 000  | 71.361 | .621      | 1.67      | 0.18 |
| 9 400 000  | 71.982 | .616      | 1.68      | 0.18 |
| 9 500 000  | 72.598 | .612      | 1.69      | 0.18 |
| 9 600 000  | 73.210 | .608      | 1.69      | 0.17 |
| 9 700 000  | 73.818 | .602      | 1.70      | 0.17 |
| 9 800 000  | 74.420 | .598      | 1.71      | 0.17 |
| 9 900 000  | 75.018 | .594      | 1.71      | 0.17 |
| 10 000 000 | 75.612 | .588      | 1.72      | 0.17 |
| 10 100 000 | 76.200 | .584      | 1.73      | 0.17 |
| 10 200 000 | 76.784 | .579      | 1.74      | 0.17 |
| 10 300 000 | 77.363 | .575      | 1.74      | 0.17 |
| 10 400 000 | 77.938 | .569      | 1.75      | 0.16 |
| 10 500 000 | 78.507 | .565      | 1.75      | 0.16 |
| 10 600 000 | 79.072 | .560      | 1.76      | 0.16 |
| 10 700 000 | 79.632 | .554      | 1.77      | 0.16 |
| 10 800 000 | 80.186 | .550      | 1.77      | 0.16 |
| 10 900 000 | 80.736 | .545      | 1.78      | 0.16 |
| 11 000 000 | 81.281 | .539      | 1.79      | 0.16 |
| 11 100 000 | 81.820 | .535      | 1.79      | 0.16 |
| 11 200 000 | 82.355 | .530      | 1.80      | 0.16 |
| 11 300 000 | 82.885 | .524      | 1.80      | 0.15 |
| 11 400 000 | 83.409 | .519      | 1.81      | 0.15 |
| 11 500 000 | 83.928 | .514      | 1.82      | 0.15 |
| 11 600 000 | 84.442 | .509      | 1.82      | 0.15 |
| 11 700 000 | 84.951 | .503      | 1.83      | 0.15 |
| 11 800 000 | 85.454 | .498      | 1.83      | 0.15 |
| 11 900 000 | 85.952 | .493      | 1.84      | 0.15 |
| 12 000 000 | 86.445 | .488      | 1.84      | 0.15 |

| N  |     |     | C       | DIFF IN C | ALLOWABLE<br>DIFF IN N | F    |
|----|-----|-----|---------|-----------|------------------------|------|
| 12 | 100 | 000 | 86.933  | .482      | 1.85                   | 0.15 |
| 12 | 200 | 000 | 87.415  | .477      | 1.85                   | 0.15 |
| 12 | 300 | 000 | 87.892  | .471      | 1.86                   | 0.15 |
| 12 | 400 | 000 | 88.363  | .466      | 1.86                   | 0.14 |
| 12 | 500 | 000 | 88.829  | .460      | 1.87                   | 0.14 |
| 12 | 600 | 000 | 89.289  | .455      | 1.87                   | 0.14 |
| 12 | 700 | 000 | 89.744  | .449      | 1.88                   | 0.14 |
| 12 | 800 | 000 | 90.193  | .444      | 1.88                   | 0.14 |
| 12 | 900 | 000 | 90.637  | .438      | 1.89                   | 0.14 |
| 13 | 000 | 000 | 91.075  | .432      | 1.89                   | 0.14 |
| 13 | 100 | 000 | 91.507  | .427      | 1.90                   | 0.14 |
| 13 | 200 | 000 | 91.934  | .421      | 1.90                   | 0.14 |
| 13 | 300 | 000 | 92.355  | .416      | 1.91                   | 0.14 |
| 13 | 400 | 000 | 92.771  | .409      | 1.91                   | 0.14 |
| 13 | 500 | 000 | 93.180  | .404      | 1.91                   | 0.14 |
| 13 | 600 | 000 | 93.584  | .399      | 1.92                   | 0.14 |
| 13 | 700 | 000 | 93.983  | .392      | 1.92                   | 0.14 |
| 13 | 800 | 000 | 94.375  | .386      | 1.93                   | 0.14 |
| 13 | 900 | 000 | 94.761  | .381      | 1.93                   | 0.13 |
| 14 | 000 | 000 | 95.142  | .375      | 1.94                   | 0.13 |
| 14 | 100 | 000 | 95.517  | .369      | 1.94                   | 0.13 |
| 14 | 200 | 000 | 95.886  | .363      | 1.94                   | 0.13 |
| 14 | 300 | 000 | 96.249  | .357      | 1.95                   | 0.13 |
| 14 | 400 | 000 | 96.606  | .352      | 1.95                   | 0.13 |
| 14 | 500 | 000 | 96.958  | .345      | 1.95                   | 0.13 |
| 14 | 600 | 000 | 97.303  | .339      | 1.96                   | 0.13 |
| 14 | 700 | 000 | 97.642  | .333      | 1.96                   | 0.13 |
| 14 | 800 | 000 | 97.975  | .328      | 1.96                   | 0.13 |
| 14 | 900 | 000 | 98.303  | .321      | 1.97                   | 0.13 |
| 15 | 000 | 000 | 98.624  | .315      | 1.97                   | 0.13 |
| 15 | 100 | 000 | 98.939  | .309      | 1.97                   | 0.13 |
| 15 | 200 | 000 | 99.248  | .303      | 1.98                   | 0.13 |
| 15 | 300 | 000 | 99.551  | .297      | 1.98                   | 0.13 |
| 15 | 400 | 000 | 99.848  | .290      | 1.98                   | 0.13 |
| 15 | 500 | 000 | 100.138 | .285      | 1.99                   | 0.13 |
| 15 | 600 | 000 | 100.423 | .278      | 1.99                   | 0.13 |
| 15 | 700 | 000 | 100.701 | .273      | 1.99                   | 0.13 |
| 15 | 800 | 000 | 100.974 | .266      | 1.99                   | 0.13 |
| 15 | 900 | 000 | 101.240 | .259      | 2.00                   | 0.13 |
| 16 | 000 | 000 | 101.499 | .254      | 2.00                   | 0.13 |
| 16 | 100 | 000 | 101.753 | .247      | 2.00                   | 0.13 |
| 16 | 200 | 000 | 102.000 | .241      | 2.00                   | 0.12 |
| 16 | 300 | 000 | 102.241 | .235      | 2.01                   | 0.12 |
| 16 | 400 | 000 | 102.476 | .229      | 2.01                   | 0.12 |
| 16 | 500 | 000 | 102.705 | .222      | 2.01                   | 0.12 |
| 16 | 600 | 000 | 102.927 | .216      | 2.01                   | 0.12 |
| 16 | 700 | 000 | 103.143 | .209      | 2.02                   | 0.12 |
| 16 | 800 | 000 | 103.352 | .204      | 2.02                   | 0.12 |
| 16 | 900 | 000 | 103.556 | .196      | 2.02                   | 0.12 |
| 17 | 000 | 000 | 103.752 | .191      | 2.02                   | 0.12 |
| 17 | 100 | 000 | 103.943 | .184      | 2.02                   | 0.12 |
| 17 | 200 | 000 | 104.127 | .178      | 2.03                   | 0.12 |
| 17 | 300 | 000 | 104.305 | .171      | 2.03                   | 0.12 |
| 17 | 400 | 000 | 104.476 | .165      | 2.03                   | 0.12 |
| 17 | 500 | 000 | 104.641 | .159      | 2.03                   | 0.12 |
| 17 | 600 | 000 | 104.800 | .152      | 2.03                   | 0.12 |
| 17 | 700 | 000 | 104.952 | .146      | 2.03                   | 0.12 |
| 17 | 800 | 000 | 105.098 | .139      | 2.04                   | 0.12 |
| 17 | 900 | 000 | 105.237 | .133      | 2.04                   | 0.12 |
| 18 | 000 | 000 | 105.370 |           | 2.04                   | 0.12 |

By Order of the Secretary of the Army:

Official:

VERNE L. BOWERS

*Major General, United States Army*

*The Adjutant General*

FRED C. WEYAND

*General, United States Army*

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